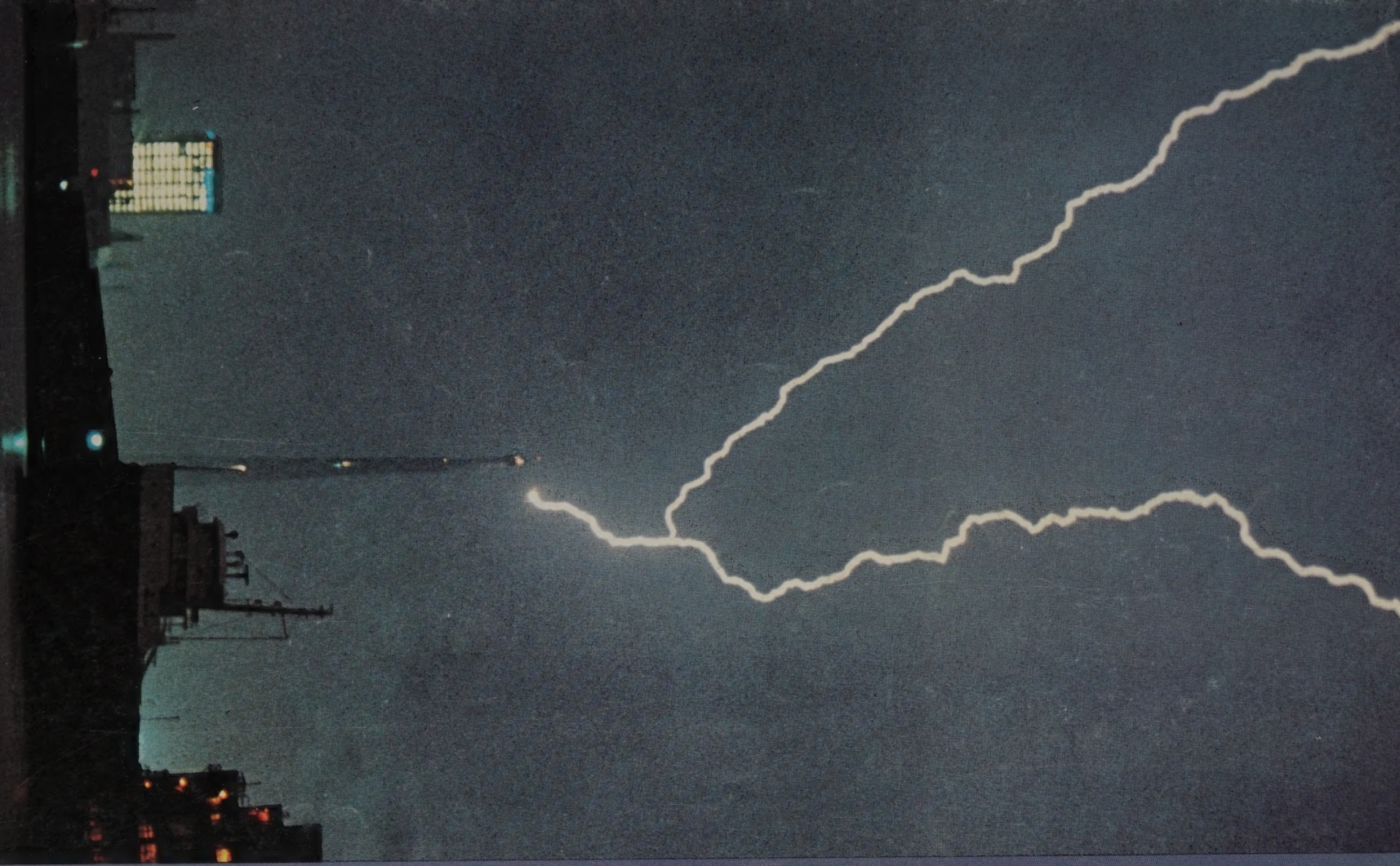


CATJ

December
1979

OFFICIAL JOURNAL
OF THE
COMMUNITY ANTENNA
TELEVISION ASSOCIATION

Oak stages a seminar in print. Session 2...

Six steps to becoming a decoder expert.

Step 1. Evaluate your pay TV system needs. Do you want to offer just one pay channel, or are you planning to add a second or third pay channel in the future? This will impact on the decoder or converter/decoder you select.

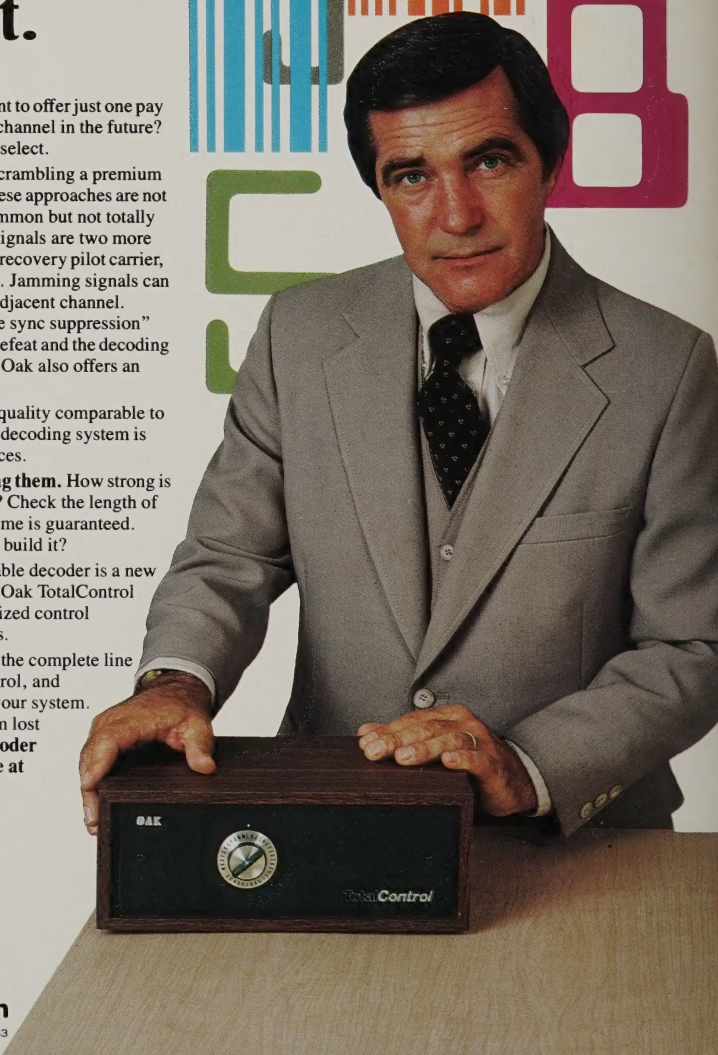
Step 2. Compare scrambling systems. Approaches to scrambling a premium program source vary among equipment manufacturers. These approaches are not equal. Inverted video and transposed rf carrier are two common but not totally secure techniques. Gated sync suppression and jamming signals are two more options. The gated sync technique requires a separate sync recovery pilot carrier, therefore using additional spectrum, often in the FM band. Jamming signals can produce interference thus causing the loss of at least one adjacent channel. Also, jamming signals can be trapped out. The "sine wave sync suppression" scrambling system is the answer. It's nearly impossible to defeat and the decoding information is "in channel." Only Oak offers this system. Oak also offers an optional pole mounted second level of security.

Step 3. Compare decoded signal quality. Is the picture quality comparable to non-encoded channels? The picture quality using the Oak decoding system is superior to all others. Subscribers do notice these differences.

Step 4. Compare warranties and the companies backing them. How strong is the written warranty and is it offered equally to all buyers? Check the length of coverage, services covered and what service turnaround time is guaranteed. Did the company selling and backing the decoder actually build it?

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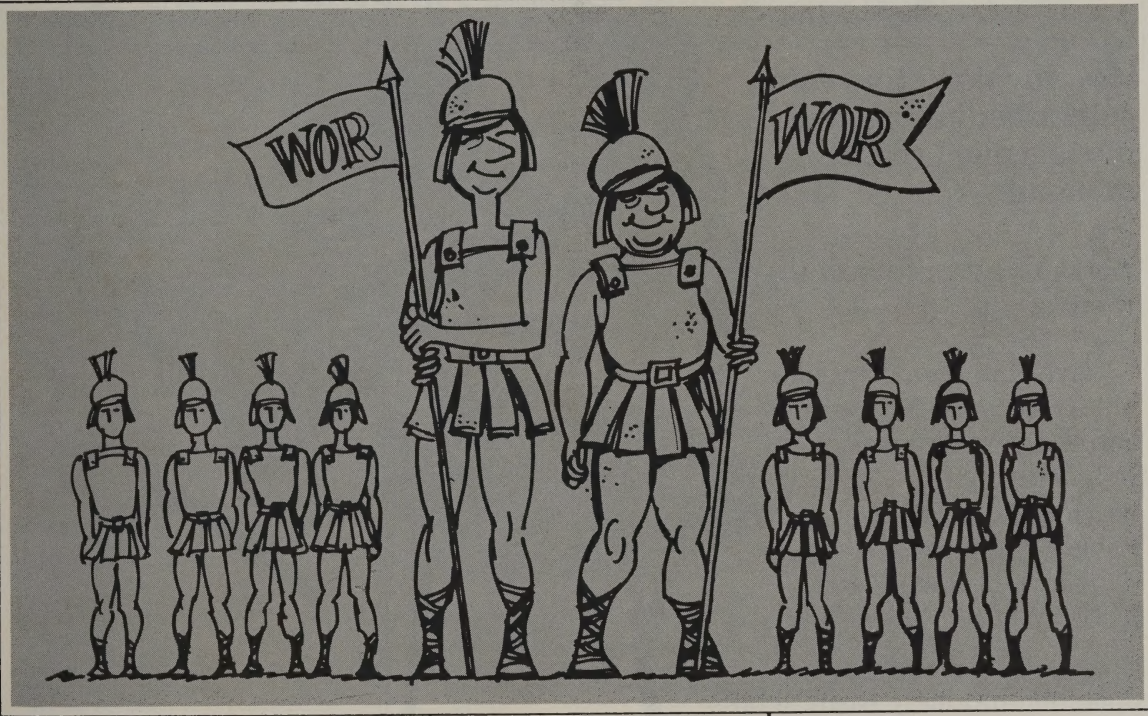


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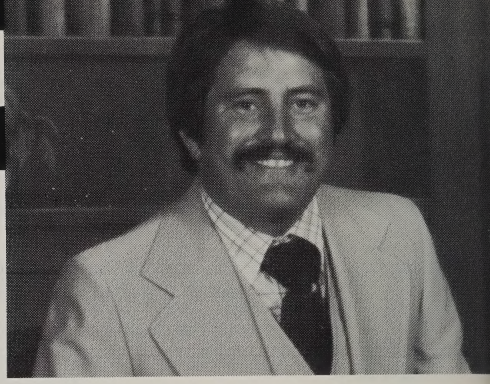
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OUR COVER

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CATA-TORIAL



BEN CAMPBELL, President of CATA, Inc.

CATA, THE COMMISSION, AND EARTH TERMINALS — A WINNING COMBINATION

It's always nice when everyone agrees on something — and it has finally happened. Several years ago the Community Antenna Television Association started promoting the idea that satellite receive-only earth terminals would be one of the most significant new dimensions added to cable television in quite some time. We had demonstrations of them, seminars on them—and even did a series of mini-CCOS road shows around the country to familiarize CATA members and all other cable operators about the potential of satellite communications.

There were a few problems, though. First of all, cable operators were not specifically allowed to construct earth terminals according to the FCC. And even if you did get permission to build one, the Commission said it had to be the one-hundred-thousand-dollar-plus variety. It just didn't make much sense. We were demonstrating earth terminals from some of our associate members that were much smaller, and much cheaper than the FCC approved kind. The pictures received were fine. There was no question, from a business point of view that the pictures we got from the "small" 4.5 meter dishes would sell on cable systems. Why, then, did the Commission insist on cable operators getting super-expensive 10 meter monsters?

Well, it's a long story, so far as the politics go — and one I won't delve into here. Suffice it to say that CATA decided to do something about the mess. We started with a filing at the FCC asking for elimination of the "10 meter" requirement, and asking further that cable operators specifically be allowed to build earth terminals. We also went to Capitol Hill and briefed the various powers-that-be up there about the problem.

Several CATA associate members pitched in with technical analyses to bolster our case and some even camped out in Washington for a while to knock on Commission doors with us to explain the situation. There were others in the battle by this time too. Other associations, other hardware and software suppliers all joined forces to push the CATA petition to permit 4.5 meter antennas.

It should be noted that while we did file the petition seeking authority and licensing from the FCC, we also told the FCC that we did not really think they had the authority to require receive-only earth terminal licenses in the first place. After all, they aren't transmitting facilities, they are receive only! The CATA Board decided, however, that it would be a shorter, and easier battle to get permission from the Commission than it would be to prove that the Commission did not have the authority to say yes or no in the first place.

The Commission finally got to the issue at the end of 1976 and considered both CATA's petition for allowing the small terminals and the petition from the American Broadcasting Company that they not be allowed. CATA won. 4.5 meter dishes for cable television were approved, and the boom started. The rest is pretty much already history—earth station applications flooded into the Commission and the stations, like mushrooms, started sprouting all over the countryside. At this point I figure that CATA saved all of its members, and the rest of the cable industry that is now using earth terminals about $70,000 apiece. Not a bad return on your dues!

But that's not where the story ends. Once we got permission to use earth terminals it became clear that the process of getting the licenses would be a huge bottle-neck. The Commission agreed. They started working with all of the cable interests to speed processing and simplify the applications. Within a year the Commission managed to overhaul its entire processing procedure so that TVRO licenses were being granted within about 45 days of receipt. That's not bad considering that the law said they couldn't process the applications for the first

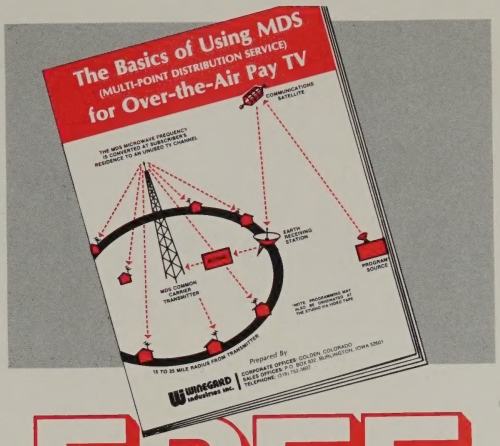
thirty days! But still, with the time spent on the coordination studies and the legal gobbledygook and the money spent to get it all done, we felt that there had to be a better way.

Once again, CATA went back to the FCC, and, along with other industry spokesmen suggested to the Commission that it really did not need this entire licensing process the way it was set up. Now, finally, the Commission has agreed. They have come out with a ruling that from now on the licensing of earth terminals is optional. Cable operators can seek a license if they want one—but they do not have to get one before building a terminal. Of course the only folks who will get the right of protection against potential future interference will be those who get the license that is available. But that is now up to the operator. It is no longer a requirement of the FCC. I think the FCC should be congratulated for taking this truly deregulatory step. Satellite technology has already changed the face of the cable industry. And now, with the availability of less and less expensive equipment, and the elimination of the costly filing and coordination fees for those who don't really need them (another $1500 or so saving for our members) the satellite revolution is really under way.

Of course anyone building an earth terminal, whether they get it licensed by the FCC or not, still must get permission from the programmers before they use any satellite signals. But that is certainly no problem for any cable operator. The biggest problem is that we don't have enough channel capacity to put on all the "goodies" that the satellite candy store is already offering! That's a nice problem to have.

With all this good news, someone was bound to try to find something to gripe about, and sure enough, they did. The concern is home terminals. Some folks seem to be worried that home satellite earth terminals will create direct competition for cable operators. I don't agree. I've said this before—look at the logic of the thing from a homeowners point of view! Cable got going in the areas CATA members serve because people were tired of playing around with two to four hundred dollar antennas in order to get television signals. Now the suggestion is that these same people will run out and buy five to seven thousand dollar antennas to get satellite feeds. No way.

The fact is that the satellite-to-home market will solve the one problem we have yet to overcome—the isolated rancher or farmer who we cannot afford to serve by cable. It will not be competitive with cable operators when the cable can bring in the same programming with much less trouble to the homeowner, and certainly much less cost. The only place satellite-to-home will catch on, in my opinion, is where cable hasn't reached yet. And as soon as cable does get there the market will already be "softened up" by the few folks who have gotten the antennas and show their friends what is available if only they could afford it! Cable will let them afford it. I look at the whole situation as an opportunity, not a threat. But that's my view, what's yours?



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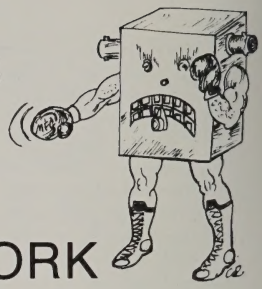
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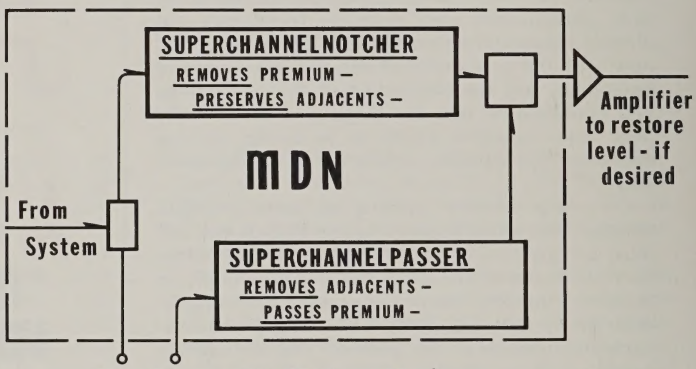


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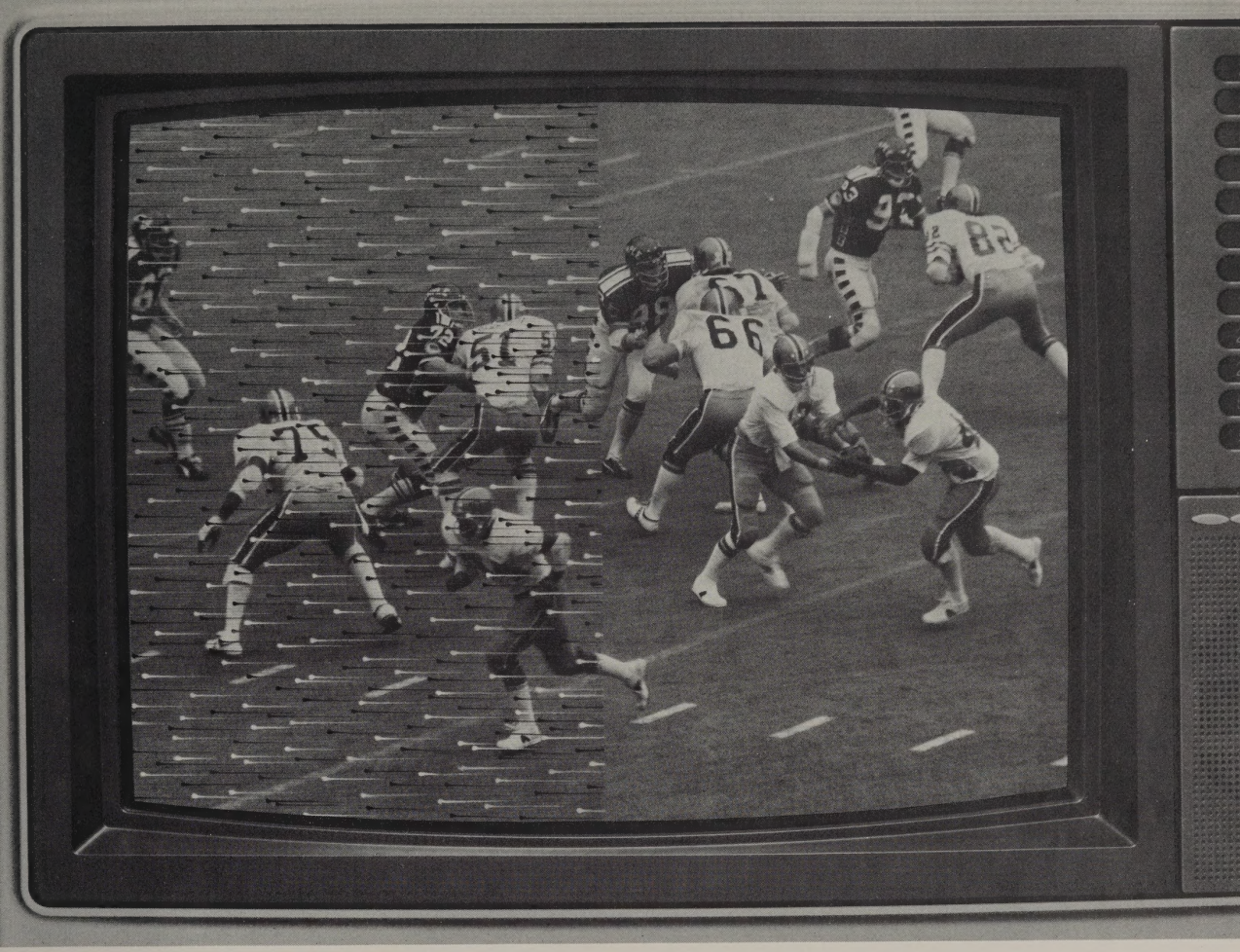
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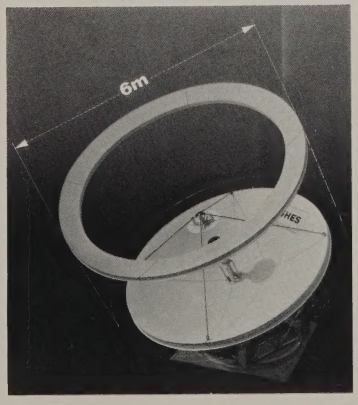
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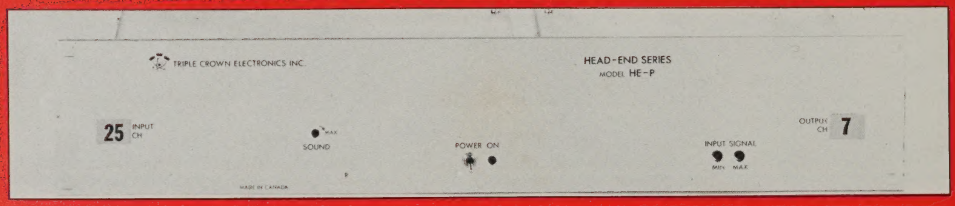
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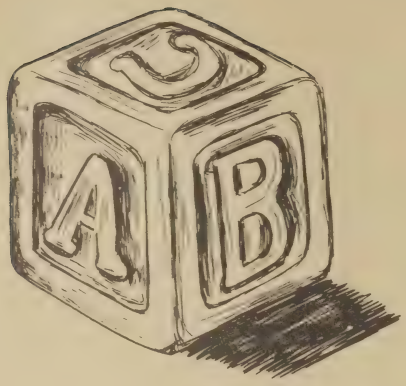
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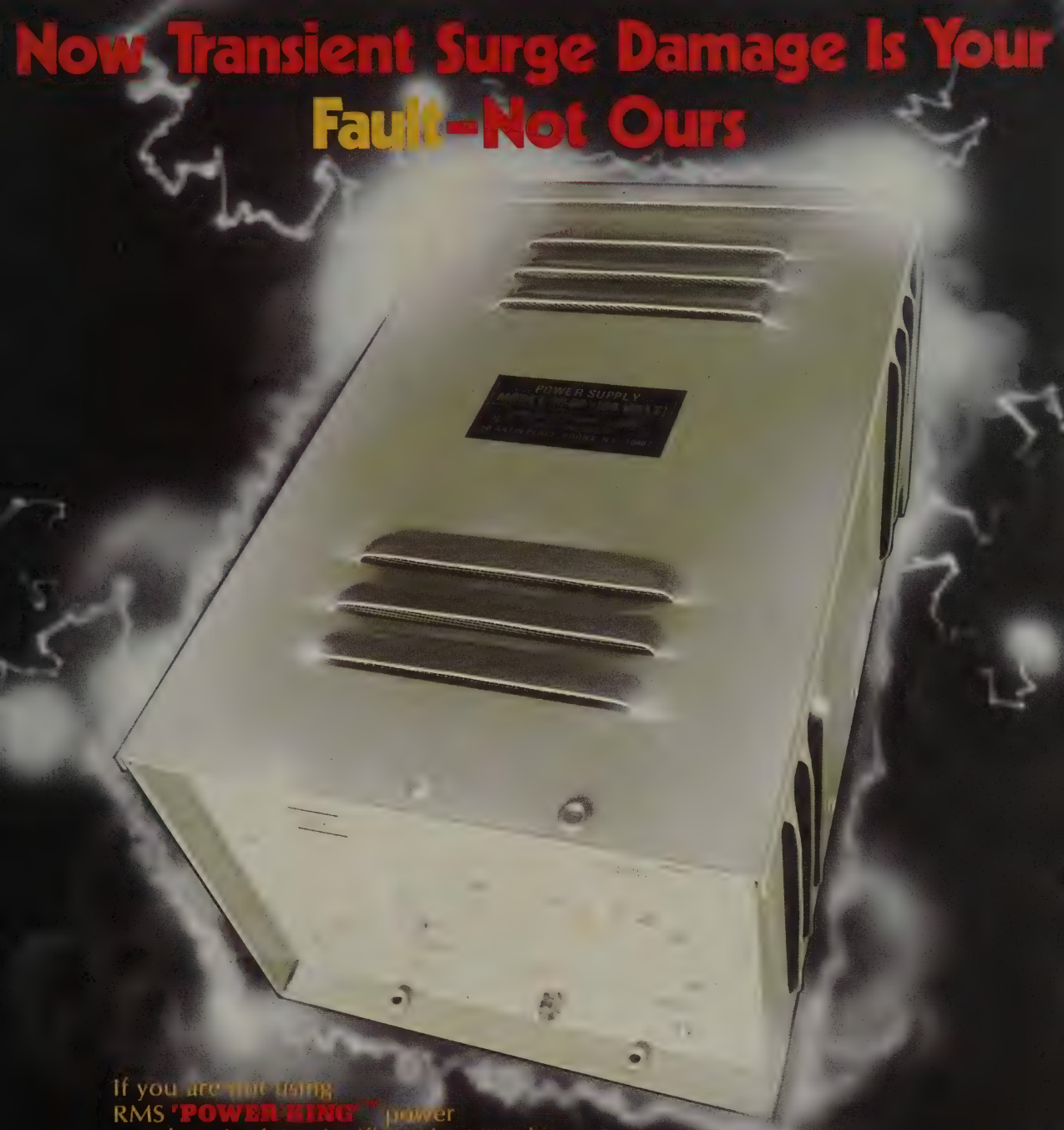
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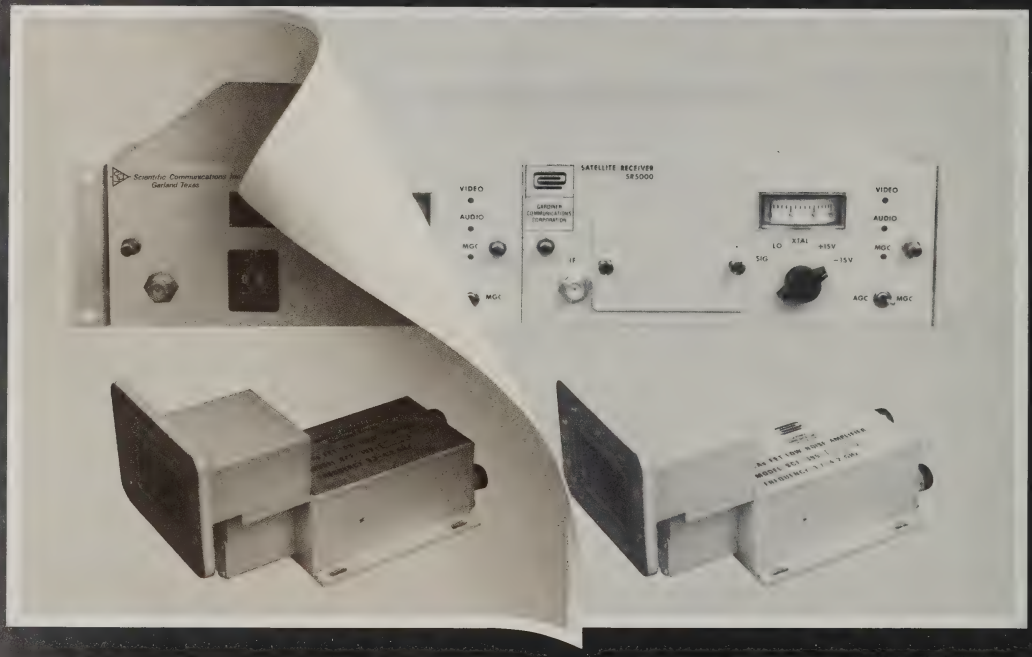
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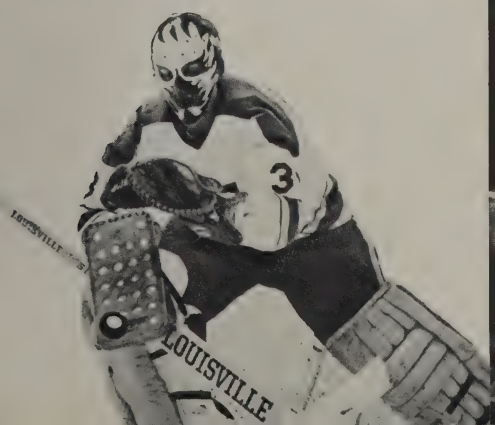
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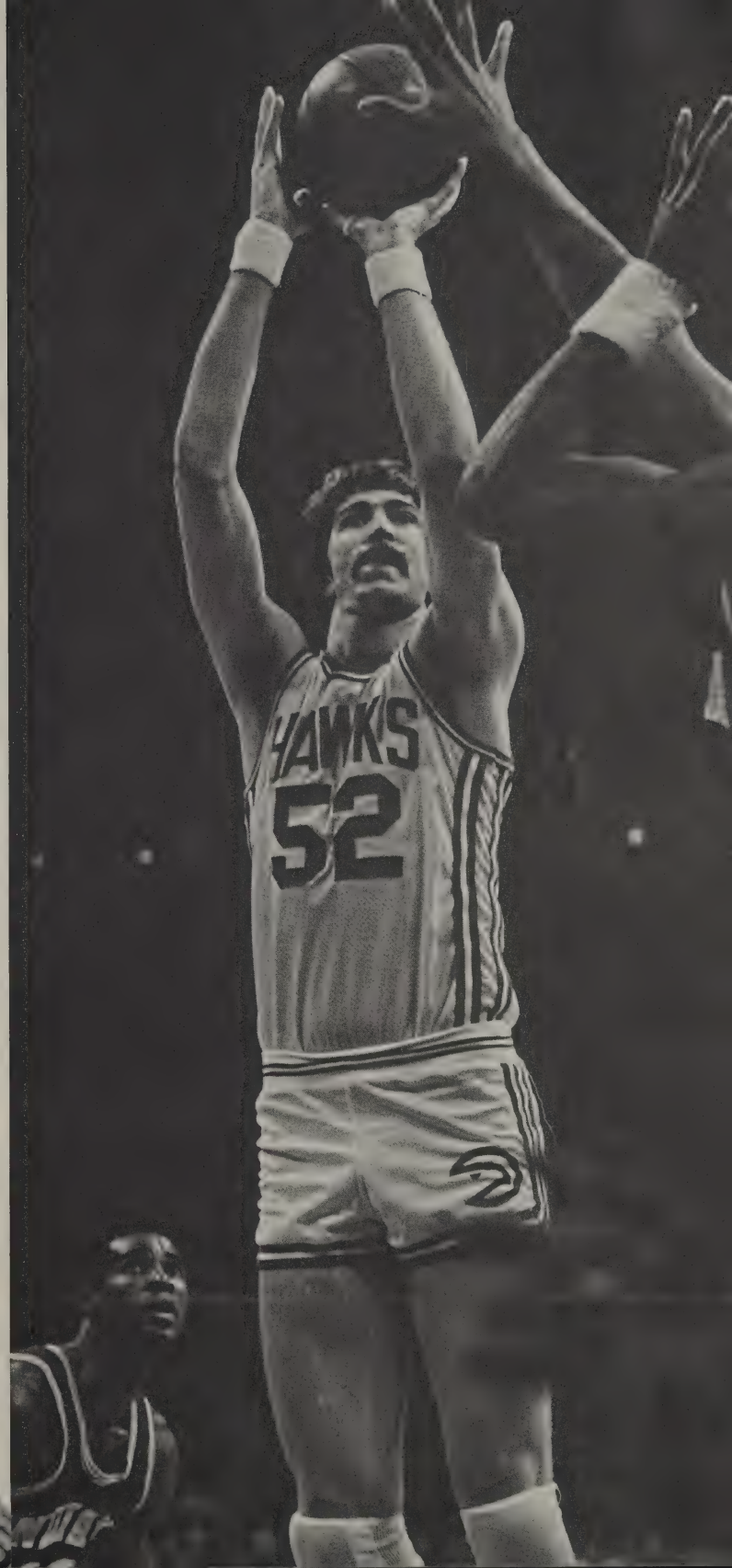
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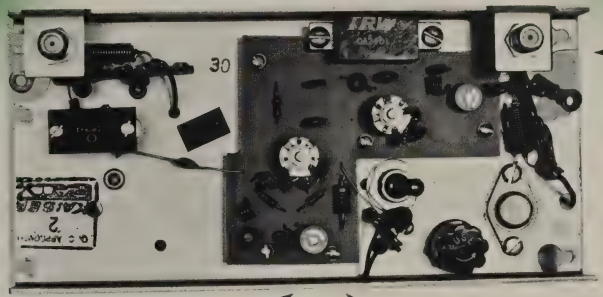
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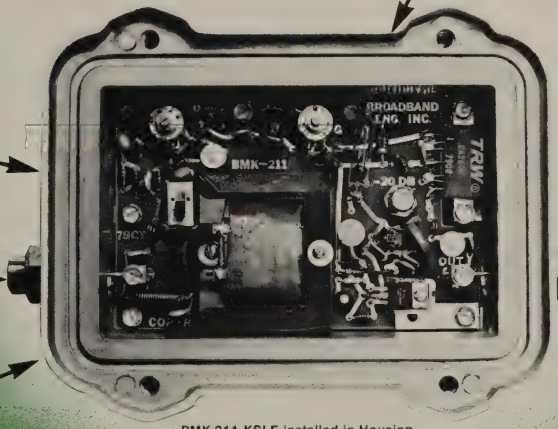
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THE BASIC CATV METER

The FSM that you use today in your cable system is the most important test instrument in your system. Depending upon what type meter you have, this instrument can be used for many different tests or calculations pertinent to your system. In this writing, we will not discuss the many different uses of a FSM or VSM, as this will be done in subsequent issues. In this article, we will explore the functions of the meter and the basic design of such units.

Most instruments now on the market are designed as shown in **Diagram 1.** The SLM or VSM is used to read two basic measurements—absolute signal levels and the relative difference between two or more levels. The absolute levels are the most difficult, as this instrument gets abuse as it is hauled around in all kinds of weather — bounced around in a vehicle, and then called upon to work under all kinds of conditions — too hot or too cold — wet or dry. Other factors affecting the accuracy would be if it is calibrated correctly and if its batteries are charged adequately to perform through a complete day of testing. Hence, two things that an operator should do daily is:

1. check calibration
2. check battery charge level

When calibrating, remember the temperature on the work bench may be up to 100 degrees different than on the pole. One way to check temperature variance on meters is to put the meter outside to allow it to become a part of the environment. All meters will change, but some more than others. **Diagram 2** illustrates the set up procedure.

A **true** field strength meter **does read** absolute levels with repeatable accuracy and with calibration accuracy which can be directly traced back to some highly accurate reference source. A **true** FSM is barely portable and if you ever bought one, the last thing in the world you would want to consider doing with it is tossing it into the back of a pickup or van. They are much **too expensive** for this kind of mistreatment.

CATV SLM instruments provide the user with a calibration chart which allows the instrument user to compensate for nonlinearities in the actual instrument. The calibration of a SLM is valid at the moment the instrument is calibrated and usually for the temperature conditions which existed in the calibration lab when the instrument was calibrated. Calibration of the meter becomes less dependable when any of the following things are factors:

1. **Aging Components**
2. **Environmental troublemakers — dirt and dust, etc.** (Dust and grime that get into the switched attenuators deter the precision of the attenuator at the input)
3. **Ambient temperature** surrounding the instrument for which partial adjustment can be built into the instrument
4. **Low or insufficient battery supply voltage** (many meters supply a battery condition check on the meter itself)
5. **Actual signs of abuse** - dents and scratches indicate the instrument has been

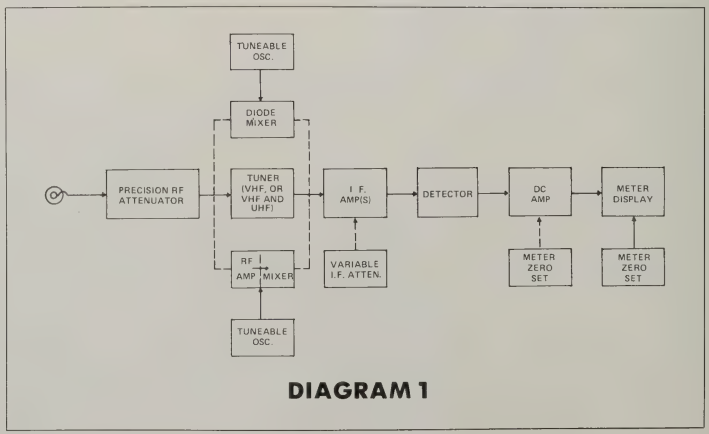


DIAGRAM 1

mistreated, dropped, and generally banged around.

6. **Nonlinearity** in the meter movement

It should be noted here that if you are purchasing a field strength meter that it should not leave the manufacturing site **without** your assurance that it has passed all the required checks and rechecks, making for an accurate instrument and removing the possibility of readings which might be potentially inaccurate.

PRECISION RF ATTENTUATOR

A typical input attenuator network is shown in **Diagram 3.** C1 and C2 are **blocking capacitors** designed to keep AC VOLTAGES (such as line amplifier powering 30 or 60 volts) out of the attenuator.

In this 10/20/20/20 dB attenuator, input energy arriving at J1 is coupled precisely to ground through the selected "pi-configuration" register group as **the switch is placed into the attenuate position.** Keep in mind that each slide switch position as a two-way unbalanced splitter, part of the energy (all but 10 or 20 dB of it) goes to J4, the output jack on the attenuator, while the precise amount called for **shunts to ground** through the pi-network resistors. The preciseness of the individual attenuator resistors is very important—1% are used in most meters. You might be able to locate 91, 110, and 150 ohms values in 1% locally, but the 317.25 ohm units in the 20 dB attenuators would give you some problems replacing.

This particular attenuator has **input and output compensation;** L1/L2 form a tuned network in the input while in the output L7/C3 and L7/C5 form additional tuned networks. These assist the alignment technican in **equalizing** the (0-900 MHz) **response of the attenuator** and like any tuned L/C networks, they will change with temperature extremes.

It is important to understand that the attenuator network ahead of the instrument is the heart of the instrument. Re-examine **Diagram 1;** the amplified gain from the IF amp(s) through the DC amp is fixed. The active portion is always reading in the minimum input range. By looking at **Diagram 4,** this can be emphasized more thoroughly.

There are any number of alignment compensating circuits in the active electronics portion of the meter. Most instruments allow one of these compensation circuits to be used by the meter operator, and is typically termed the **Tuning Compensator,** or RF calibrator which is located in the IF amplifier portion and not on the tuner.

But the meter itself is basically a **one range** instrument, reading minimum scale of the ranges provided. It becomes a **multiple range** instrument by placing ahead of the basic range, precision attenuators which expand the basic range by the 10/20 dB range steps of the attenuators. This is a pretty standard approach for virtually all types of measurement instruments where voltages in particular are concerned.

The precision attenuator is actually an add-on instrument ahead of the basic meter electronics. It has its own special problems apart from those of the active portion.

Needless to say, the CATV business is something **less** than a sterile environment, thus allowing dirt, grime, dust and moisture to sift into virtually everything used. The SLM and its precision attenuator are no exception.

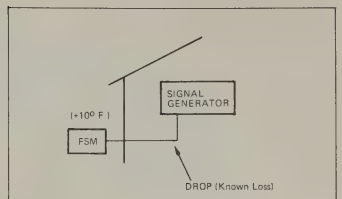


DIAGRAM 2

Most manufacturers use either step rotary switches or slide switches which are carefully sealed to keep the unwelcome elements from seeping in, but some will, none the less. What happens then is that the contacts stick and the slide switches have to be forced to operate. Often something will give and the switch then hangs up. Another common problem, equally aggravating, is contact corrosion due to moisture seepage. Switch contacts are usually silver plated wnich resists corrosion about as good as anything. But eventually, especially with an instrument that gets moved around into the field and thus exposed to dry and wet conditions, enough moisture will get into the slide switches to corrode the contacts making for a poor contact. This radically changes the accuracy of the 10 or 20 dB attenuator slide switch. Usually when the switch is in the **off** position and at the time when you believe you have no attenuation **in, it always becomes worse!!**

Aside from dust, dirt, grime, and moisutre, the precision attenuator has but one enemy

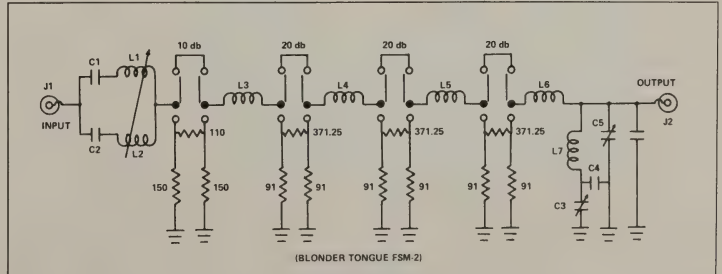


DIAGRAM 3

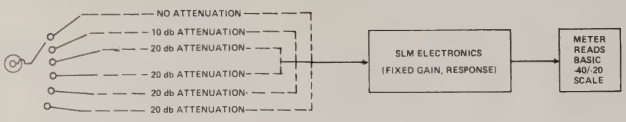


DIAGRAM 4

(usually)—**electrical shock.** Early instruments did not employ any form of AC blocking and when an instrument was placed on a line with AC voltage present, the AC naturally zapped the attenuator. Most are sealed up, or designed to function without operator attention. The sealing process is double duty to keep all the unwelcome factors out and to prevent any direct pickup of the off-the-air signal. If you ever have any reason to open a meter up to inspect it (usually when the contacts have gotten dirty and you want to clean them), be **very careful** and note exactly how it comes apart. Pay attention to all sheilding, including the heavy aluminum foil which is used for shielding. Contacts can be cleaned often without opening the attenuator by using any first class tuner-contact spray lubricant. If you are going to check resistor values, keep in mind we are dealing with 1% resistors and they cannot be accurately checked on a $9.95 imported VOM.

The quickest way to check any particular slide switch attenuator on a meter is to compare all switch positions of the same value. That is, reference a signal level that is constant and alternately slide 20 dB steps in and out, checking one against the other. They **should** read the same. **Diagram 5** shows how you can check your internal attenuator by using a good quality external attenuator or inline pade.

A good quality step attenuator is perhaps one of the best investments any CATV system can make, provided the step attenuator is carefully taken care of and used only for indoor calibration checks of SLM units, and not moved around from place to place.

Finally, if the meter's attenuators have been damaged, it is possible with some units to bypass the SLM attenuator and place an external lab quality attenuator in front of the unit. The calibration may not hold totally, especially where the SLM attenuator has output tuned compensating circuits as shown in **Diagram 3.** But it will get you by until you can have the SLM attenuator repaired or replaced.

RF HEAD

Looking back again to **Diagram 1,** you will see that the signal goes from the attenuator to the RF head. With some units, it is a tuned passive preselector and in others, a tuned RF amplifier.

After the attenuator the whole circuit is a one scale device developing and reading out RF voltages in a single 20 dB (scale) range. The amount of gain is constant, within manufacturing tolerances, across the whole tuning range of the instrument. Because gain is easier to achieve at lower frequencies and more difficult to get at higher frequencies, the SLM designer has to compensate internally for gain-fall off at the higher frequencies to ensure that gain over the full tuning range is constant. If this were not done, circuit gain at lower frequencies would amplify the indicated signal level on lower channels beyond their true values, reference the lower-circuit gain higher frequency signals. So the circuit gain at the higher frequencies determines the package circuit gain since it is the lowest denominator. And lower frequencies are compensated with tuned circuits to retard the circuit gain in those ranges.

A SLM that used no RF amplifier stage goes through a tuned preselector directly into a mixer. Compensation, if used, is built into the preselector in such a way that the losses are higher at low frequencies. The intent up to the mixer (diode) is to keep all signals to the mixer equal, regardless of the frequency they come into the unit.

For example, the designer must be careful to see that a true 500 microvolt signal at channel 2 arrives at the RF to IF mixer input with the **same signal** (voltage) level as a true 500 microvolt signal at channel 13, and at UHF if a UHF head is included. This is not easy over a wide frequency range (54-216 MHz) and it gets more complicated once we add super band ranges and UHF to the instrument.

As shown in **Diagram 6,** the output of the attenuator is taken through a tuned preselector and goes either directly to a mixer which goes from RF to IF, or through a RF amplifier stage and then to the RF to IF mixer. At the output of the attenuator any signals present on the input line are also present. Since we are only interested in **one carrier** at a time, some function must start the

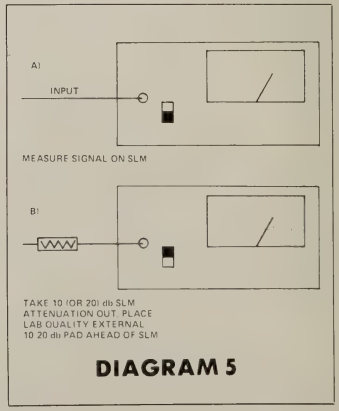


DIAGRAM 5



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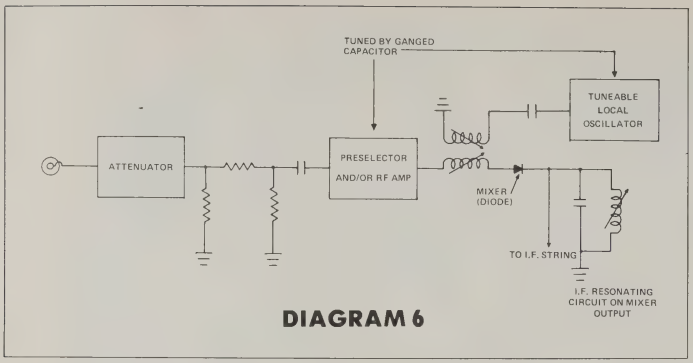


DIAGRAM 6

process of separating the desired carrier from the others present. This is the job of the preselector.

The preselector is a tuned bandpass filter controlled by the multi-ganged capacitor which varies the operating frequency of the SLM. One or more sections of the ganged capacitor vary the bandpass over the spectrum of coverage of the SLM by tuning not only the preselector bandpass filter but the local oscillator stages as well.

Remember that the precision attenuator is a fixed unit; that is, it reacts the same over the full coverage range of the SLM and there is no tuning involved. Also the IF amplifier portion stays the same. There is no tuning involved, regardless of the frequency of the carrier being measured. What does change is the pre-selector, a RF amplifier stage (if there is one) and the input circuits to the mixer stage that combines the incoming RF carrier with a locally generated oscillator.

In Diagram 6, you can see that the incoming signal from the attenuator is filtered for frequency selection, and applied to either a RF amplifier stage or directly to the mixer without RF amplication.

The mixer is a fairly straight forward device that has **two inputs and one output.** One input is the preselected signal, the second is a locally generated carrier produced by a stage called a local oscillator. The output of the mixer stage is the mathematical sum (or difference) between the two input frequencies. For example, when the local tuneable oscillator is tuned to 75.25 MHz and the incoming signal passed by the tuneable preselector is 55.25 MHz, the difference between the two signals is 20 MHz. If the IF amplifier section of the SLM is in fact 20 MHz, the output of the mixer (20 MHz) becomes the input to the IF section of the unit. In all cases, this stays at the same frequency but by tuning the ganged tuning capacitor, we vary simultaneously the local oscillator frequency, which is part of the gang tuning, and the preselector tuned bandpass filter. When the local oscillator is tuned to 231.25 MHz, the preselector is tuned to 211.25 MHz, producing a signal at the input of the IF of 20 MHz (only that signal is originally a 211.25 MHz signal from a channel 13 transmitter). **Diagram 7** illustrates this.

The preselector, the RF amplifier stage, and the input to the mixer are mainly exercises in tracking. That is, an exercise in designing two or three stages which each do separate things, but they do them simultaneously so that they constantly work together to achieve a single objective, which is an output on the IF section input frequency. The channel selector knob, continuously tuning, on the front of a SLM is the common bond that seals all of these stages and functions together. It operates the ganged tuning device(s) which must simultaneously track each of the separate stages to produce the successful broad frequency coverage of the SLM.

Following the mixer device which converts the input signal down to a common intermediate frequency, we have two or three stages of IF amplication and filtering. The choice of the IF frequency for a SLM is not without plenty discussion, as there is no **right answer** to the decision making process since few manufacturers agree. Some with several meters in their instrument line have several IF frequencies. It is an accepted principle of IF-choice that the lower in frequency you go (closer to 0 MHz), the greater the stability of the IF and the greater the selectivity of the IF.

Further, it is an accepted principle that in IF choice the lower the actual frequency of the IF, the smaller the separation distance between the desired carrier (say 175.25 MHz channel 7 video) and the local oscillator frequency. Since the local oscillator is a signal, and it is right there in the same box as the input to the mixer, the **last** thing we want is the energy from the local oscillator gumming up the works for our weak 175.25 MHz measurements.

So we want to go low in frequency to get selectivity and stablity and still stay far enough away from the desired carrier measurement frequency with the local oscillator to keep it from being a problem. It

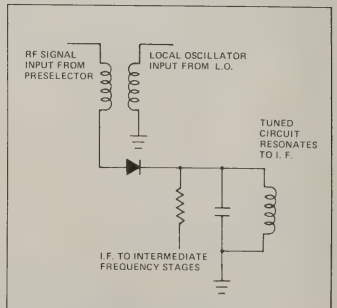


DIAGRAM 7

is one of those endless trade off with which every design engineer must cope.

If we are trying to receive 175.25 MHz and we have a 20 MHz IF, our local oscillator is operating on 175.25 MHz plus 20.0 MHz or 195.25 MHz. If our IF is 40 MHz and we want 175.25 MHz, our local oscillator is running on 175.25 plus 50 MHz or 215.25 MHz. There are exceptions, but most of the more common instruments utilize IF's between 20 and 40 MHz.

The IF section of the SLM is required for gain and bandpass selectivity. The gain requirement is part of the overall problem of plugging in sufficient voltage amplification at some point between the input jack to the SLM and the terminals on the back of the meter movement to net accurate full scale deflection in the basic range. Most meters get a good share of this voltage gain in the IF section.

The selectivity requirement is just what it says—the ability to separate the desired carrier from any and all others that might be expected to be present. The assumption most SLM designers start with is that they must be able to separate the visual carrier from the lower adjacent aural or vice versa. **Diagram 8** shows a typical selectivity curve.

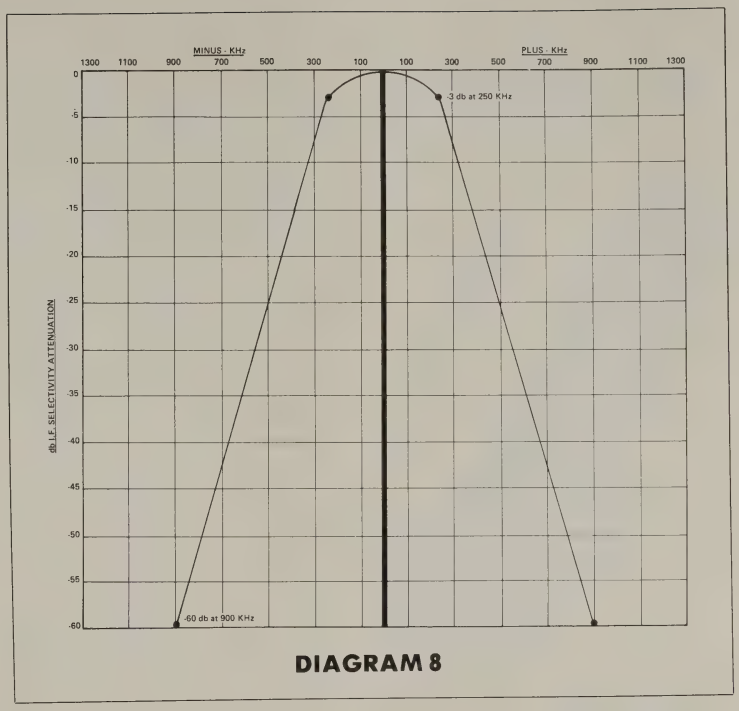


DIAGRAM 8

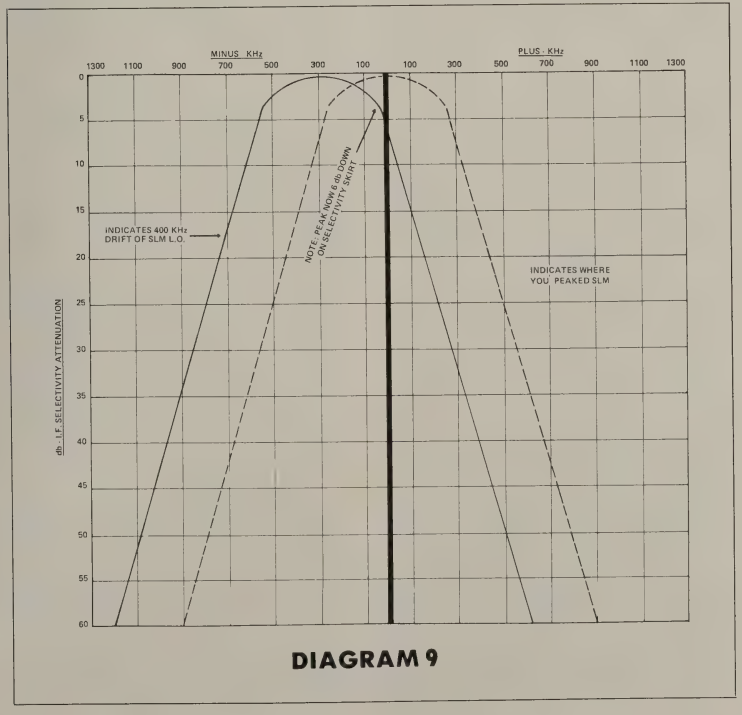


DIAGRAM 9

The selectivity function is another one of those engineering trade-offs. It is no trick to make the meter super-selective, but too much selectivity would be a disadvantage for the meter operator and would require considerably more expensive circuits. **Stability then enters into the equation of overall selectivity.** The sharper the selectivity the more precisely the operator must set the multi-ganged tuning knob dead on frequency to find the desired carrier and its modulation for peak detection. Having an extremely selective circuit would complicate tuning and require much slower mechancial tuning rates. Even if you are willing to accept the much slower tuning rate or the units were equipped with a two-speed knob drive, there is another more severe problem when there is too much selectivity. This would be the stability of the unit.

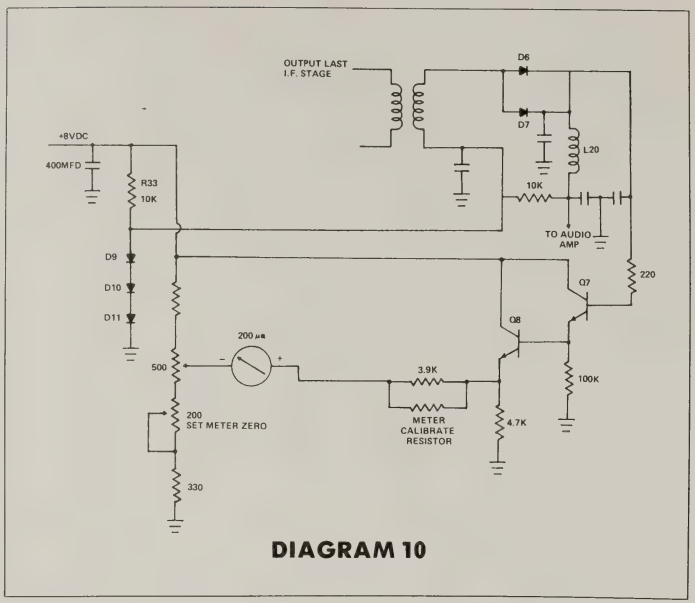


DIAGRAM 10

Remember that to tune from channel 2 visual carrier (with a 20 MHz IF) to channel 3 visual carrier, we have to knob tune the multi-ganged capacitor to vary the local oscillator frequency. At channel 2, the L.O. is 75.25 MHz and at channel 3 it is 81.25 MHz to produce a 20 MHz IF. The local oscillator is temperature stabilized in design, which means capacitors utilized in its circuit have special characteristics that compensate for temperature changes. Still, local oscillators do drift. They go up and down in frequency simply because in the price class of many SLM instruments, it is not always feasible to build in rock solid (crystal like) stability.

The more selective the bandpass of the SLM, the quicker a small drift in the local oscillator frequency will move the desired signal out of the bandpass of the IF. See **Diagram 9.** If you ever have had the experience of setting a SLM on carrier frequency carefully and walking away for a few minutes, when you return you might discover the SLM is no longer precisely on the correct frequency—then you have experienced local oscillator drift. Even with the kind of selectivity curve found in **Diagram 8,** drift is not uncommon in some units.

SLM units with a IF attenuator are nothing more than a calibrated means of varying the otherwise fixed gain of the IF block. This is usually done as a means of giving the operator an extra operating control.

DETECTOR

The RF signal voltage constructed through the amplifier stages is turned into a meter reading voltage in the detector stage. The detector is typically a diode, although it may be a transistor. The detected video signal is not capable of driving a video monitor because the selectivity of the SLM is far too tight to allow proper passage of the approximately 4.0 MHz wide video information found in a broadcast TV signal.

Some units use snap-in diode units that rest in position between two metal prongs. They are pressed into position and held in place through mechanical strain. This allows the user to replace the diode should it ever go back without having to get into the circuit with a soldering iron. However, with this advantage comes the disadvantage that occasionally the mechanical clip that holds the diode in place will release one end or both end of the diode. This is most apt to happen when the meter is accidently dropped. When this happens the meter stops working altogether or functions intermittently. The answer to this problem is to open up the meter and reseat the diode. The clip-in diode arrangement can also cause some problems in areas of highly corrosive atmosphere. The plated contacts on the clip, like the slide switches in the attenuator, can oxidize or corrode making less efficient contact between the diode metal end pins and the prongs on the clip.

DC AMPLIFIERS

The detected voltage present at the output end of the detector is not sufficient to drive the meter movement in most units. A fairly straight forward DC voltage amplifier solves the problem by amplifying the detected signal.

As in **Diagram 10,** you can see that many meters use the DC amplifier as a convenient place to apply temperature compensation to the operation of the entire unit. Silicon diodes D9, 10, and 11 are forward biased to give temperature characteristics equal to, but opposite to D6, 7 (detector circuit) and Q8 (DC amp). R33, on +8 volt line supplies forward bias for Q7 and Q8 which generate thermally corrected current caused by the voltage drop across D9, 10, and 11. This temperature compensated source is applied via L20 and detector diode D6 to the base of DC amp Q7, therefore providing bias for DC amp Q7 in the no signal condition.

POWER SUPPLY

SLM power supplies are more involved than you might expect because of two requirements. When the SLM is to be utilized as a field strength measurement device, the accuracy of the measurements is only as good as the stability of the amplifier/detector circuits.

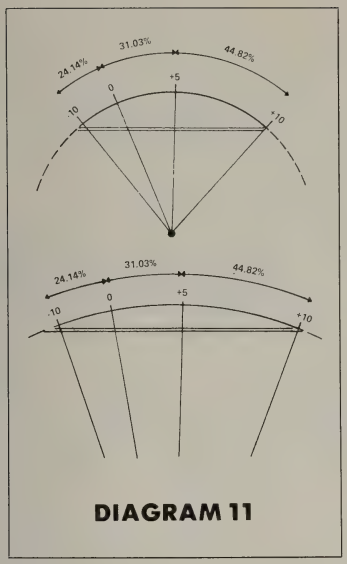


DIAGRAM 11

Stability due to changes in environment is one thing—instability due to voltage varying on the transistors and diodes is something else.

In the power supply circuitry, one finds substantial differences between models. Where one will house a single transistor regulator, another will use five. Where one will reference to voltage only, another will cross reference voltage and current.

In addition to stability the SLM power supply is a two-source device. Virtually all field units operate from an internal battery supply or standard power mains. Most of us use the instrument in the battery supply mode most of the time. Because battery life is limited we are concerned with how long the batteries will sustain the units. The manufacturers have been pretty universal in adopting an interlock switch which automatically shuts off the unit when the front cover is closed, which is a very helpful feature if you are constantly on the move and sometimes you forget to take care of this when a measurement is completed.

The choice of batteries is another one of those trade offs. Until the very recent introduction of small physical size, long life, high current rating cells, if you wanted longer life, you had to use batteries with very large cases. At some point, this would be a problem for the user because of the size of the package, and thus, the weight. Manufacturers rate the useful life of the batteries they recommend in different ways from 8 to 16 hours of continuous use, or even 180 hours of intermittent service. When a SLM draws lower current and operates down to a lower battery cutoff, voltage is going to get more useful battery life out of a set of batteries. Battery check indications are usually made **after** the regulator circuit, thus you are reading the voltage in a go-no-go situation. If there is sufficient regulator voltage to run the unit, the batteries are in fine shape and you can proceed to do your job. As soon as the regulator cannot maintain the minimum operating voltage the circuitry requires, you have a no-go situation.

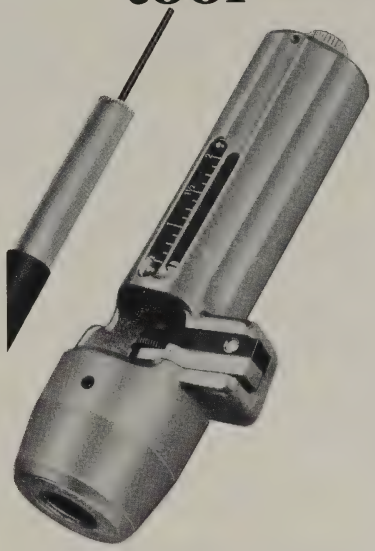
THE METER

The choice of a meter movement is basically made with the idea that the user wants to be able to see what the meter levels are—quickly, clearly, and accurately. Large meter faces and multicolored scales are being used to accommodate this.

Most meter movements are made to the specifications of the SLM manufacturer, either as completely custom movements and faces, or as face variations of standard meters that some meter manufacturers carry in their line. The basic meter movements are low value, such as 0-200 microamp units.

If you want to check the operation of your meter movement, you can connect a good VOM or VTVM into the "Video Out" jack found on most meters. Starting off around 0-299 microamps, scale down the external VOM/VTM in voltage steps until a full scale reading on your SLM cor-

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It was a classic Texas showdown. When Storer Cable TV introduced Showtime and (dare we say it?) Home Box Office to a new build market just outside of Dallas last July, a lot of people in the industry were skeptical. After all, when the two big guns come to town, one of them has got to get out by sundown, right? Wrong.

As of October 25, 1979, the figures show that of all basic cable subscribers, 94% have opted for pay TV. And, of those, an astounding 65% have chosen both SHOWTIME and the other maxi service!

Why?

Because Storer presented a total entertainment package to Grand Prairie. And since most subscribers looked at cable as a way to maximize their viewing options, they took both pay services so they wouldn't "miss anything."

They were right.

Many of you think the two services offer the same programming. They don't.

For instance, Showtime offers a wide range of totally unique blockbuster specials. Superstars like Elton John, Willie Nelson, Tony Bennett, Crystal Gayle, and Juliet Prowse taped live in concerts from Moscow to Nashville. Dazzling Las Vegas reviews. Uncensored comedy from Chicago, New York, Houston, and San Francisco. Exclusive productions of Broadway and Off Broadway shows. And movies and mini series produced especially for us.

Packaging the two pay services together, Storer was able to give the Grand Prairie audience more options, more convenience, and better selection than ever before.

And Showtime is committed to working closely with the cable system to successfully package these dual service advantages to the consumer.

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In a new build, dual market situation, both Showtime and the other major pay service experienced high penetration



numbers and overwhelming success. And the affiliate reaped the benefits of both!

By offering Showtime and another pay service, Storer's maxi pay revenue increased by a whopping 85%.

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responds to the same on your external meter movement.

The meter movement is a 20 dB linear scale. With the exception of a couple of installer meters that have 30 dB scales, full left stop to full right stop on the meter face is a 20 dB range. Manufacturers of meter movements and CATV SLMs have worked together to build a linear movement, but there have been problems because of the log voltage function and meter movement shortcomings. Look at your own meter—closely. Note how much of the scale is compressed to the left hand side. Refer to **Diagram 11.** Two meters are shown in scaled relationship to illustrate the difference in meter scale approach.

But now, the matter of meter movement linearity, the linear response of the meter movement itself. Obviously, a meter movement that bunches 50% of the electrical scale in 24.14% of the mechanical display area is not very linear. What about the electrical accuracy of the meter movement? If the mechanical display vs. electrical units is non-linear, what about the response of the electrical display to linear changes in drive voltage?

If you want to read an absolute level with the maximum accuracy possible, you should do so with a scale reading that places the meter needle someplace between 60% and 80% of full mechanical scale—not **electrical** scale.

The truth is that any meter movement's linearity response is not good on the low end. The needle deflection becomes less and less accurate in the region below 25% of full mechanical scale. When you are reading or trying to read accurately levels that are in the −10 to 0 range on your scale face, you are potentially as much as 2-3 dB out of mechanical accuracy on top of the electrical accuracy of the SLM itself.

If the SLM has an absolute accuracy of the + / − 1.5 dB, this will only be true in the best situation, which is when the needle is around 60-80% of full mechanical scale, between +7 and +8 typically. ON the low end between −10 and 0 dB on top of the absolute meter accuracy of the SLM circuitry, which is typically + / − 1.5 dB you can also be as much as 2-3 dB out of mechanical display accurate. Your potential inaccuracy is as much as +/−4.5 dB in the low display ends of the scale, which is a bunch.

To avoid these compounded errors, high accuracy requirement readings should be made, where possible, with the meter scaling in the +7/+8 region. However, getting there with 10/20 dB step attenuators may be a problem and require external fixed or switchable precision lab quality pads ahead of the SLM.

As we stated in the introduction to this material, it is our purpose here to explore the functions of the field strength meter instruments and discuss how various designs go about putting the circuit together. A further study for you would be to explore in detail specific instruments as to their performance, including a comparison of the desirable and less desirable features, covering the use of dB and microvolt scales. You need to look, in detail, at instrument calibration procedures on specific instruments and explore means to make chart recordings and read co-channel interference. With your particular needs in mind and what you want to do with a field strength meter, you can pick the best instrument for doing the best job for your system.

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Part II — A Study of Lightning

LIGHTNING PROTECTION FOR BUILDINGS, TOWERS & PERSONNEL

By
Dr. Rodney B. Bent
Atlantic Scientific Corp.
P.O. Box 3201
Indialantic, Fla. 32903

ABSTRACT

This second of a series discusses the purpose of a lightning rod and the basic requirements for lightning protection for buildings and towers. Other types of protection such as overhead wires are discussed along with dubious elimination and radio-active systems. The effects of lightning on persons and anaimals is also discussed.

THE LIGHTNING ROD & ITS CONDUCTORS

The Lightning Rod. The basic lightning rod system is the only system generally accepted by the major lightning protection committees. Before we discuss its actions, let us first investigate the facts relating to lightning protection systems that have little scientific justification.

It is a common misconception that lightning rods discharge clouds and thus prevent lightning. The rod only serves as a means to route the lightning harmlessly to ground by diverting the lightning when it approaches the striking distance discussed in last month's report. In the two hundred years since Benjamin Franklin investigated lightning, many manufacturers have tried to influence the public in the dissipation principle of lightning protection or elimination. This technique most certainly does not work and the lightning physicists' thoughts on this subject are discussed in masterly fashion by Golde in the following statement:

> **"It is a manifestation of human weakness that a prejudice once acquired tends to be retained even in the face of over-whelming factual evidence contradicting the basis on which it was founded. In the realm of science a prejudice may be termed a misconception. Such a misconception which has persisted for over two hundred years and which is still widespread is the belief that a lightning conductor has the ability, or indeed the purpose, of dissipating silently the electrical charge in a thunder cloud thus preventing the "protected" building being struck".**

There are several manufacturers of either radioactive lightning rods or lightning dissipation systems. The predominant scientific belief, however, is that neither of these systems are any benefit over the conventional lightning protection system. Extensive studies have been performed recently on dissipation arrays which only serve to enhance what scientists dating back to Franklin over 200 years ago have said; namely, that these arrays do no more than a conventional lightning rod and indeed probably do less. These studies have examined the historical theoretical and experiemental aspects of the arrays and have also investigated the arrays on site at several installations.

The arrays are believed by many non-scientists to give off significant corona discharge under thundercloud conditions so that the electrical characteristics of the storm are drastically changed. The claims indicate that a large area around the array is protected because this so-called excessive ionization either reaches the cloud and lowers its potential below the discharge level or provides a protective ion cloud over the protected area. These claims cannot be so as such a protective cloud would have to contain enough charge to make it more dangerous to the ground than the thundercloud itself. Secondly, corona ions dissipated from an array would

recombine in normal air when only a few hundred feet above the ground, and there would also be less ions from an array than from a single conventional rod or even a few trees.

All factors related to these arrays indicate that they are not as good a lightning protector as a conventional single conductor. A U.S. Navy report (1) and FAA report (2) discuss both sides of the topic.

In order to examine the claims related to radioactive lightning rods, it is necessary to consider the physical process of a discharge to a conventional rod. When a lightning rod is in the area of a lightning leader the electric field around its tip would be extremely high and the air in this region would be in glow discharge which indicates millions of free electrons moving at the point. As the electric field increases, this ionization process or corona current also increases to arc discharge and a spark reaches out to meet the downward coming leader, forming a path for enormous currents to flow.

Radioactive rods contain a certain amount of radioactivity in the area near the tip of the rod, supposedly to enhance the ionization and hence attract the lightning leader over larger distances. These claims have been examined experiementally and theoretically by many scientists with negative results. In effect, the analysis shows the corona current from the radioactive rod is slightly higher than that from the conventional rod, as the manufacturer claims, only when electric fields are low such as under a fair sky. When a thunderhead approaches and the electric fields build up, however, the radioactive rod gives off less corona current than the conventional rod and is, therefore, less likely to be struck. This can be explained by the fact that the ionization cloud produced around the rod by the radioactive source provides an ion shield around the tip reducing its effectiveness in sending up the necessary upward leader spark.

The corona discharge from a conventional rod was found to exceed that from a radioactive rod by an order of magnitude under lightning-like electric fields indicating that radioactive rods are much less capable of influencing the path of a lightning discharge than a conventional rod. An example of failure of radioactive lightning rods was illustrated on the Vatican's Berni Colonade Building in Rome which is protected by such rods. On the 6th of March, 1976, the Papal Crest was struck by lightning and knocked off indicating failure of such a protective system.

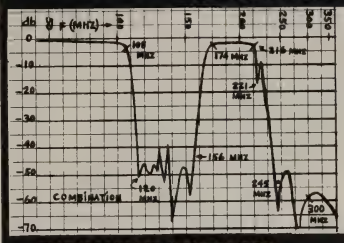
The lightning rod has the purpose of intercepting a lightning strike and deflecting it from the structure. When several lightning rods are to be put on a building, one should develop a commonsense solution which will strike a reasonable balance between protection and cost.

It is possible, with care, to use existing gutter and rain pipes to obtain protection at reduced costs, but care must be taken when incorporating modern metalic roofing materials to be part of the system. Lightning can penetrate

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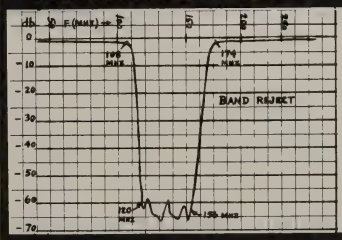
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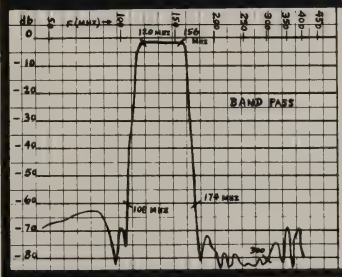
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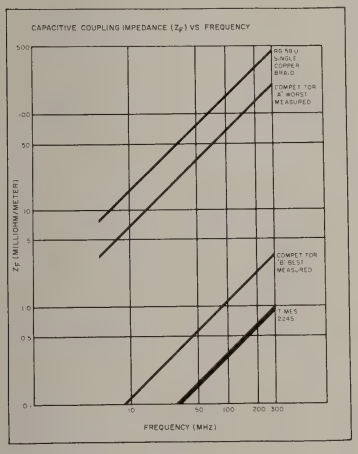
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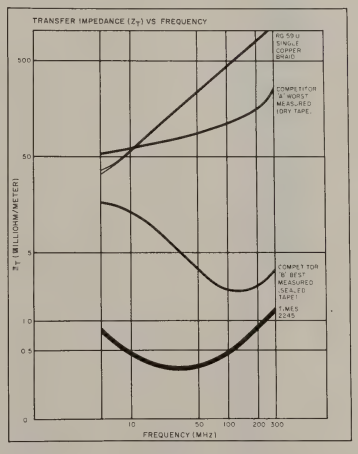
Today, when radiation from drop cable has become a serious concern to many people, Times has taken action to alleviate the problem significantly.

To begin with, we've developed an instrument called the Radiometer which, for the first time, measures radiation definitively. Until now it was anyone's guess. Radiation characteristics were based on relative ratings and not always accurate. But the Radiometer measures capacitive coupling and transfer impedance. The characteristics of the test sample and the test chambers are measured separately. So now we have radiation data that's absolute, accurate and dependable.

Number two and more important, we've used the Radiometer in Research and Development to bring you improved drop cable. How good is the cable? Thanks to the Radiometer, you can see for yourself in the comparative tests shown on the right.

Times 2245, with its sealed foil/double braid construction, is proven to be far superior to every other cable on the market. The best competitive cable (a sealed foil type) was higher in transfer impedance and capacitive coupling. The worst competitive sample we tested was a dry foil construction. And just as a point of reference, we included standard MIL SPEC RG59U, the original CATV drop cable.





Not shown but also vital is data taken after flexure testing. After many hours of being subjected to simulated severe wind conditions the radiation from one competitor's cable increased by a factor of 40. But the tough construction of Times 2245 kept it from degrading one iota. What's more, we've improved all of our drop cables. Times can offer you cable with the lowest radiation in every price range construction. And this is no idle boast. Radiometer tests prove it.

The Radiometer, however, isn't limited to duty at the manufacturing level alone. CATV operators can utilizes its unique ability to check quality of every reel of drop cable purchased. That's why Times is making the Radiometer Model TNX-247 on a production basis. Selling price: $975.00 including three different size test chambers to cover all RG-59, RG-6 and RG-11 cable.

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metal sheets of 1 mm thickness or more, and perhaps the cost of such repair might be acceptable. The minimum thickness is defined in certain codes to be 0.3 mm for copper, and 0.5 mm for other metals. Some roofs use metal foils of less thickness. A lightning strike to this type of roof will not only burn a large hole, but can cause large areas of foil to be torn off due to the mechanical effects.

Down Conductors. When lightning strikes an air terminal the injected current must be transferred by the shortest possible path to ground. The down conductor has this function, but because the inductance of this down conductor is a major factor in determining the occurrence of the dangerous side-flash to some internal grounded object, it must also have the lowest impedence that can be afforded.

The inductance of a down conductor is directly proportional to its height. By paralleling two down conductors their combined inductance is reduced to approximately one-half that of a single conductor and so on. The down conductors should not be spaced too close together however, otherwise the above rule is not accurate. The importance of having at least two down conductors is therefore a considerable advantage in reducing the dangerous side-flash, the action of which was discussed last month. Right angle bends in a down conductor also increases the inductance and such a design needs a careful consideration.

Once a lightning strike has been intercepted and passed to the surface of the earth, it is the function of earth electrodes to discharge the current into the ground. Two important factors are the ground resistance, which plays a part in side-flashing, and the potential distribution over the ground surface. If the ground resistivity is high, advantages can be achieved by bonding the down conductors to water pipes to lower the resistance to ground. The risk in side-flashing is thus determined exclusively by the inductance.

Side-flashing can also occur below the ground to buried metal pipes or wires and care must be taken in the design and positioning of the grounding electrodes. Typical values of impulse breakdown in soil are 2 to 5kV/cm, which leads to side-flashes of several meters. In air the value is 9kV/cm and brick and concrete has a slightly lower breakdown strength.

It is interesting to note that the length of a ground rod has a much more significant effect on the resistance than its radius. Curves demonstrating this effect are shown in **Figure 1**, which also implies that little benefit is, on average, achieved by extending the rod beyond 2 or 3 meters or increasing its diameter beyond 1.25 cm. Strip electrodes are beneficial where high resistivity ground exists below a layer of low resistivity.

Materials. The type of material used for roof and down conductors seems to be governed by

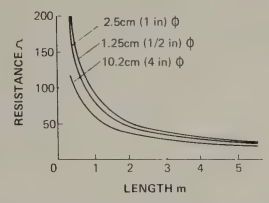


Figure 1. Variation of ground resistance of rod electrodes of different diameter with length (British Code)

tradition. Copper, aluminum and galvanized steel are all acceptable but there are conflicting opinions as to whether the material should be of rod, tube, strip or stranded form. Stranded copper is not deemed acceptable in the codes of several countries, although it is accepted in the USA code. Copper or copper alloys must not be used on a building with aluminum fittings.

A strong corrosive effect can be caused by rainwater dripping off copper conductors onto some metals such as zinc or lead which are often used on buildings. Dissimilar metals should be avoided as far as possible, and one should be aware that stranded materials are more severely attacked by corrosion than solid conductors.

Corrosion plays a high risk underground, in particular to aluminum which is totally unacceptable. The electrolytic properties of some soils cause corrosion to all these metals, as do stray currents produced by DC railway lines on DC high voltage systems where the earth is used as a return path. Cathodic protection can help eliminate this type of problem.

Zones of Protection or Attraction. The cone of protection under an elevated grounded rod can be measured in terms of the ratio of the protected radius R to the height of the tip of the rod, H. This value R/H lies between 2 and 1/2 if one believes the lightning protection codes of various countries. In fact, **Table 1** indicates these values for the United States, United Kingdom and South Africa.

TABLE 1 PROTECTIVE RANGE AND ANGLE

Country	R/H	° (degrees)	R/H	° (degrees)
			Dangerous Structures	
United States	2:1		1:1	45
Britain	1:1	45	0.58:1	30
South Africa	1:1	45		



Figure 2. Upward going lightning leader from Mont San Salvatore, Switzerland. Note upward going branches. (Photo by permission of Dr. R. Orville SUYNA)

These statements seem to disregard the many cases in which direct lightning strikes have in fact been observed to occur well within the protected zone. One such strike was to the base

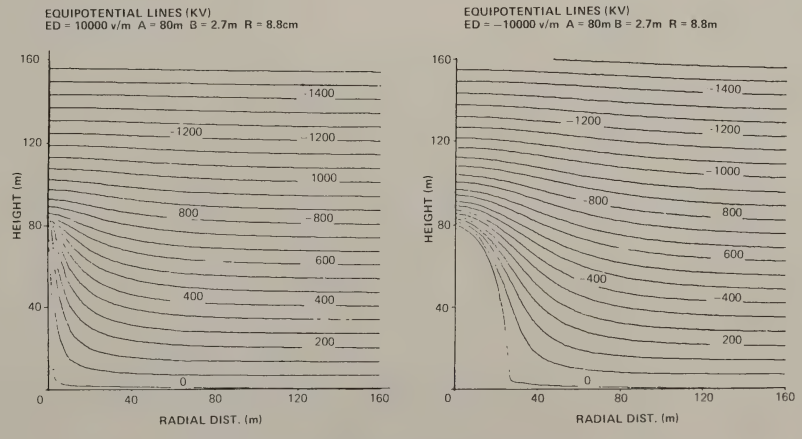


Figure 3. Equipotential lines around pointed and blunt towers


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of grounded Apollo rocket in its vertical blast-off position.

One may conclude that for a structure up to, say 20 m height, the distance over which a lightning stroke of average intensity is likely to be attracted is the striking distance, shown in last month's article, to be about 40 m, which is twice the height of the structure. If lightning enters the striking distance zone it will probably be attracted to the tip of the rod. Outside this region it is unaware that the rod is there and will continue on to ground.

The striking distance to tall structures is likely to be somewhat different than indicated above as the height of the structure is significant with respect to a leader step. Laboratory experiments, as well as those from a 70 m tower in Switzerland, indicate that the striking distance can be assumed to be a slightly larger distance than for lower structures. No protective zone can be assigned to a tall structure, even if a striking distance can be estimated. A very tall structure, say over 600', may also initiate upward going leaders quite often such as that shown in **Figure 2** from a tower atop a mountain in Switzerland. Note the upward going branches to the channel.

First of all, a leader with a considerable inclination towards the vertical might not be attracted at all to the tip of the structure. Direct strokes to the sides of such structures or to earth near them have been reported. Secondly, the tip of such a structure is the seat of strong point discharge currents and the resulting space charges which are being shifted by wind may affect lightning discharges.

Figure 3 shows 2 cases of equipotential lines around 80 m high towers of different diameter. Thunderstorm electric field conditions of -10,000 V/m are assumed; however, the equipotential line distribution gives the general picture for any value of the ambient field requiring only a change in scale. The left plot is of a pointed tower having a 8.9 cm radius of curvature and shows the equipotential lines just around the tower are greatly modified from the parallel field situation. It is striking how closely the lines follow the tower along the vertical structure and how they are concentrated just around the top. But just a short distance away from the tower the parallel field situation is regained. Around the blunt structure with 8.9 m radius of curvature, the picture looks quite different. The equipotential lines are not as closely gathered around the blunt structure as they are around the pointed one, but the field is effected more at greater distances as is apparent by the line concentration. This implies that under appropriate high fields corona ionization occurs only in the immediate vicinity of the sharp tower, but over a larger volume around the blunt tower.

The field lines run perpendicular to the equipotential lines as represented in **Figure 4.** The collection area is marked off, for which the field lines terminate on the tower. If the lightning leader was coming down, and the phenomena was assumed weak, then theoretically it would follow one of the field lines. But of course the high charge carried in a downcoming leader modifies the entire field line pattern; hence, the collection area cannot be strictly considered a lightning cone of attraction. This distance is quite different for the two structures, it is roughly half the height for the pointed tower and equal to the height for the blunt structure.

These figures indicate that the cone of protection for a sharp lightning rod is less than 30°, unless the lightning stroke is of sufficiently high intensity to allow an upward leader to be initiated from the point.

There is much evidence, however, to indicate that the sharp point may protect itself and not

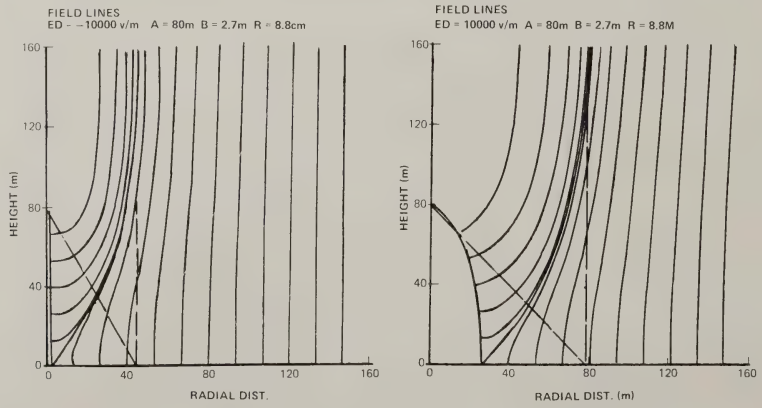


Figure 4. Electric field lines and collection areas



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reach an arc condition before a blunt point in the area. Examination of **Figure 4** illustrates how lightning can hit the side of a tower or indeed be drawn to ground within the so-called cone of attraction from outside this region.

Lightning strokes of more than average intensity are likely to be attracted over much larger distances which can be regarded as a beneficial attribute of a lightning conductor. On the other hand, as we have just shown, weak strokes may not be intercepted at all, as was the case in the strike to the base of the Apollo rocket and many strikes to the side of the Empire State Building. Such a feature may be acceptable in the case of an ordinary building, but cannot be tolerated for certain danger structures where sparking can cause an explosion.

The concept of a protective zone is undoubtedly helpful to the non-expert in visualizing the action of a lightning conductor, whether this be vertical or horizontal. However, its limitations should be clearly appreciated and its application to a tall structure is completely unjustified.

THE BASIC REQUIREMENTS OF LIGHTNING PROTECTION

The relative need for lightning protection at a facility is dependent on many factors as indicated by Smith[3]:

(a) Type or usage of facility
(b) Personnel safety
(c) Prevalence of lightning
(d) Type of construction
(e) Contents
(f) Economic risks
(g) Degree of isolation (relative height of surrounding structures)
(h) Type of terrain, and
(i) Height of structure

The decision to provide protection may be based primarily on one factor alone. Some possible single factors can be personnel safety requirements, reduced insurance rates, or to meet an imposed lightning protection code.

Three basic requirements must be fulfilled to provide protection against direct lightning strikes to a structure:

(a) A conductive object must be provided to intentionally attract the leader stroke;
(b) A path must be established that joins this object to earth with such a low impedence that the discharge follows it in preference to any other, and
(c) A low resistance connection must be made with the body of the earth.

The lightning protection system should conform to an accepted set of guidelines. Codes and standards have been established in many countries to provide the necessary guidelines. Every code or requirement have one thing in common, and that is diverting a direct strike to earth. The

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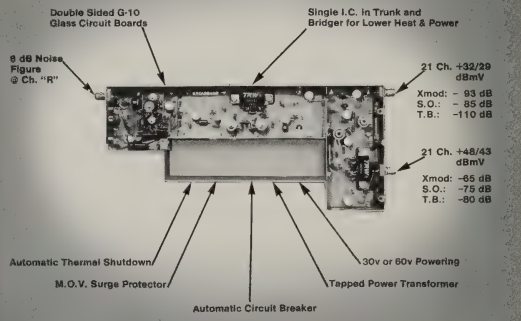
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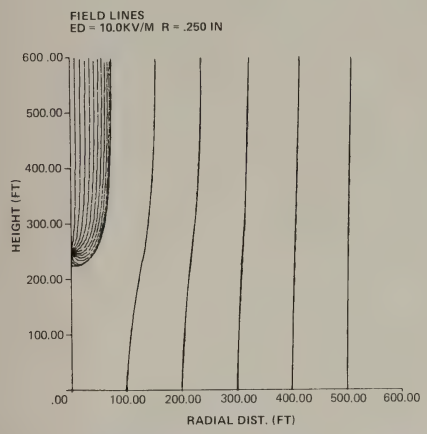


Figure 5. Electric field lines in the vicinity of an elevated grounded wire

primary difference in the various codes is the philosophy used in achieving an effective protection system.

The United States has two nationally accepted codes: the National Fire Protection Association's Lightning Protection Code (ANSI C5. 1),and the Underwriters' Laboratories Master Labeled Lightning Protection System (Standard UL 96A). The major difference between the two is that the Master Label can be certified upon both a factory inspection and labeling of the lightning protection materials and upon performance of a field inspection by an authorized inspector.

LIGHTNING PROTECTION BY OVERHEAD WIRE

Danger facilities of large dimensions requiring the best possible protection should be provided with a system of caternaries suspended from tall masts. These catenary wires must pass to ground some distance away from the protected structure so that the lightning current may go to ground at a distant point.

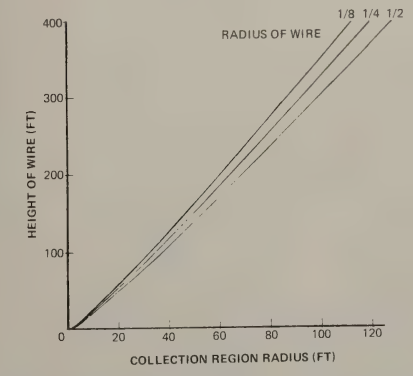


Figure 6. Field line collection area as a function of wire size and height

The grounding wires should radiate away from the structure, be strip conductors and should not be bonded to the structure. The overhead wires should be far enough from the structure to eliminate side-flashing which was described earlier and the protective angles from the wires must cover the building structure.

Theoretical investigations of the electric field around elevated grounded structures are summarized in **Figure 5** which shows the field lines around a grounded wire at 250 feet during a thunderstorm. From Figure 5 it can be seen that if a weak lightning leader came toward ground within 80 feet of the wire it would be attracted ot it. Hence, if two wires were spaced 160 feet apart any such leader approaching ground in that region would be attracted to the wires, thus protecting the structure under them. The protection area is a function of wire size and height, as shown in **Figure 6.**

Photographs taken of lightning striking a wire stretched over a canyon in New Mexico by Dr. Moore, verify that it did indeed strike the wire underneath on various occasions. At times when a strong lightning leader approaches, the function of the wire, then in a high corona discharge state, is to provide the upward leader thereby attracting the downward stroke to the wire.

If this type of lightning protection is carefully planned, chances of failure will be extremely

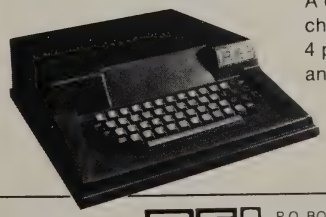
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small, however, the installation and maintenance problems of such a system may be considerable.

PROTECTION OF TOWERS

Because of the height of structures such as transmitting towers, they are likely to be subjected to a large number of lightning strokes, and if they are positioned on rocky ground the equipment can sustain large potential differences. Many towers have equipment that is often put out of action and damaged. Protection against the effects of lightning must, therefore, be concerned with the risks of damage to the structure, the equipment and personnel.

To illustrate the problem we are up against, consider two such towers in Flordia where there is a high lightning incidence rate. A 600 foot Loran Tower in Jupiter and a 1200 foot tower at Eglin Air Force Base were both monitored for lightning strikes a few years ago. Theory indicates that the 600 foot tower is not likely to initiate many upward going leaders and should, therefore, be hit about twice per year with normal downward strokes. The 1200 foot tower, on the other hand, could initiate considerably more upward strokes and yet still only receive two downward leaders. Photography and current measurements confirmed these theoretical views as the Loran tower was hit twice in one summer storm period while the 1200 foot tower was hit over a dozen times. Most of the other damage reported was due to power surges.

If a tower is to be hit by lightning, then nothing will be able to deviate the stroke elsewhere and we must make sure that it passes harmlessly to ground. If the ground resistance is low (~10 ohm) and the guys are also well grounded there is good chance that little damage will result. If the ground resistance is poor then the cable lines coming to the tower will be more attractive to the lightning current. Any antenna or other equipment on top of the tower may be in danger if it is necessary for it to be above the tower top; however, with careful planning of surge suppression to all power and signal lines on the tower, damage can be significantly reduced. This will be discussed next month.

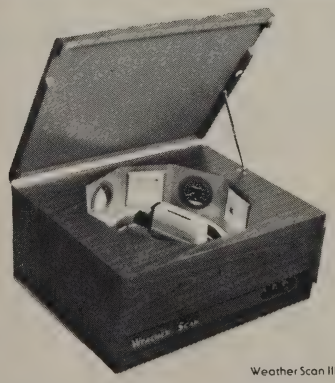
It is usually not necessary to add a lightning rod to the tower, after all the tower is a lightning rod itself, but one must be careful that there are no high resistance joints between tower sections. Copper bands should be bonded between sections to the steelwork. Cables should also pass down the center of the tower as lightning current will attempt to flow down the outside of the structure.

Any equipment in buildings at the base of the tower should be well grounded and **must** be bonded to the grounding system of the tower.

PROTECTION OF PERSONS AND ANIMALS

Most fatal casualties are due to direct strikes or to side-flashes to the head. In these cases part of the current may be discharged through the brain and to the respiratory center located near the back of the neck at the top. This can lead to a cessation of breathing. Alternatively, part of the current may be discharged through the heart

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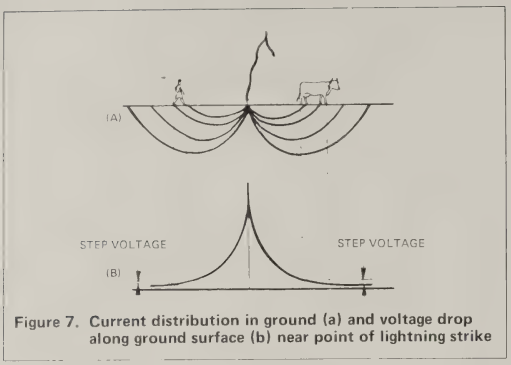


Figure 7. Current distribution in ground (a) and voltage drop along ground surface (b) near point of lightning strike

which can cause asphyxia or rapid twitching of the heart (ventricular fibrillation). People who have survived lightning strokes have usually been subject to high step voltages and not direct strokes or side-flashes.

The potential distribution over the ground determines the step voltage to which a person, or an animal, is subjected when striding close to the lightning strike point. **Figure 7** indicates the current distribution and step voltage near to a lightning strike. The step voltage is proportional to the specific resistivity of the soil. For the hiker in the illustrated sample, no current passes through the heart, hence the damage will not be fatal and probably be only muscular in nature. The unfortunate cow, however, has its heart in the current path.

With a direct strike to an individual the dangers are obvious but there are many occasions where the individual can survive. The flash contains such a high voltage that it is likely to flash over the outside of the body with only minimum current passing by the two most critical regions, the heart and the brain section



Figure 8. Arborescent burns on back of lightning victim

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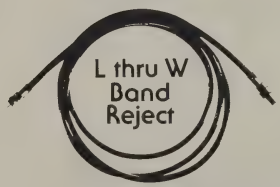
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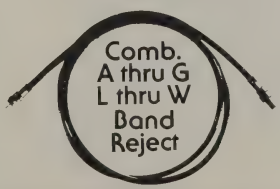
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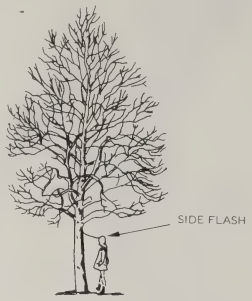


Figure 9. Side flash from tree

controlling breathing. The individual's heart may stop beating or go into fibrillation and the person may stop breathing. Often no permanent damage has occurred and with heart massage and mouth-to-mouth recussitation the individual may survive.

A lightning stroke victim may at times even show evidence of arborescent first degree burns such as those shown in **Figure 8.** These burns disappear within 48 hours and are not really burns but perhaps are due to rapid electron motion in the skin.

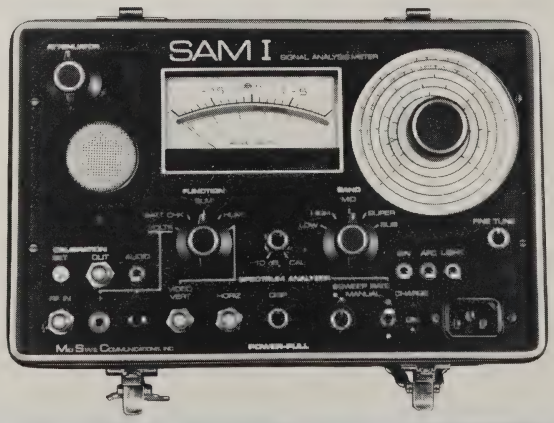
Side-flashes were discussed in last month's article and these are dangerous when sheltering under a tree as shown in **Figure 9.** Every year there are reports of people who have been killed under trees and this is usually as a result of side-flash and not the step voltage. Burns on the body usually show evidence of such a side-flash from the tree trunk or one of its branches. An isolated tree on open ground is particularly likely to be struck and to shelter under it, a person is asking for trouble.

Side-flashes can also occur from metal fences on insulating posts or other large metal bodies above ground such as antennas and clothes lines.

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3. Smith, R. S., Lightning protection for facilities housing electronic equipment, FAA-RD-77-84, May, 1977.

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Steve J. Birkill On Experimental Earth Terminals

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A single-stage GaAsFET Low-Noise Amplifier

The 'Pravda' newspaper page shown here is typical of reception at my location in Sheffield, England, from the Russian satellite Ghorizont-2 in geostationary orbit in the Statsionar-4 location at 14°W, over the Atlantic. The 3695 MHz transponder has an estimated 36 dBw EIRP in this direction, and is received daily on a low-cost terminal substantially unchanged since early 1978. An 8-ft. dish antenna mounts an integrated feed assembly incorporating a single stage gallium arsenide FET amplifier, several stages of bipolar amplification, a transistor oscillator and mixer, and 20 dB of intermediate frequency amplification over the range 450 to 950 MHz. Overall noise temperature of the system is between 180 and 200°K. In this article I shall describe the GaAsFET stage, with constructional details for the practically-minded experimenter.

The transistor used is the Plessey GAT 5. This device has a gate length of some 0.7 microns, and is capable of good noise performance at frequencies as high as 12 GHz, when mounted in the P103 package. Let not its British ancestry deter you—Plessey have remained in the forefront of microwave device development, and have an active marketing organization in the United States, with sales offices or representatives in 18 states. The GAT 5 will readily achieve noise figures of better than 1.5 dB at 4 GHz. The Plessey Company does incidentally have a half-micron GaAsFET the GAT 6, in its catalog, which promises better than 1.0 dB noise figure at 4 GHz and 2.5 dB at 12 GHz in package form, but I have been unable to obtain one to date. The GAT 5 though is available 'off-the-shelf'.

Diagram 1 shows the circuit. Input and output matching networks each consist of three transmission line elements, two series and one shunt, to transform the 50 ohm source and load impedances to those required by the transistor so that it can deliver its optimum compromise between high gain and low noise. The shunt elements are decoupled at the end remote from the transistor, and provide convenient paths for application of bias voltages. Further decoupling of the bias lines is provided by low-pass quarter-wave filters, with shunt capacitors C2 to C7 ensuring decoupling is maintained

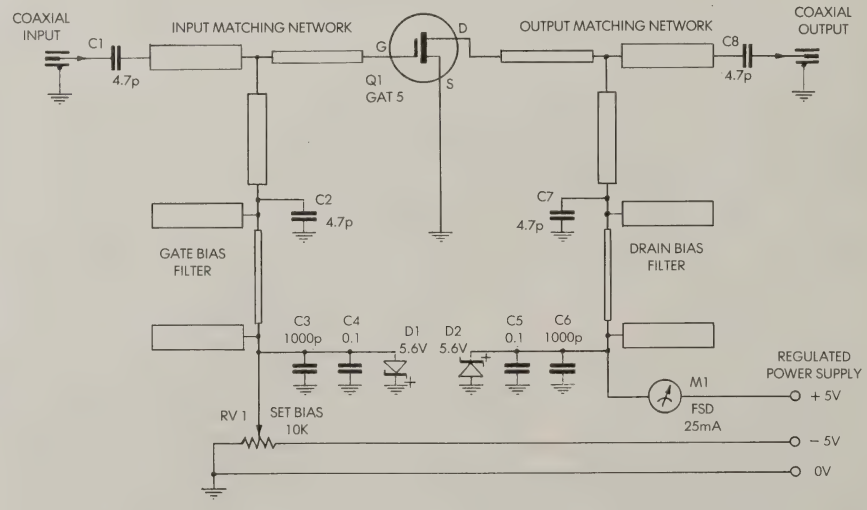


DIAGRAM 1
SINGLE-STAGE GaAsFET LNA CIRCUIT SCHEMATIC

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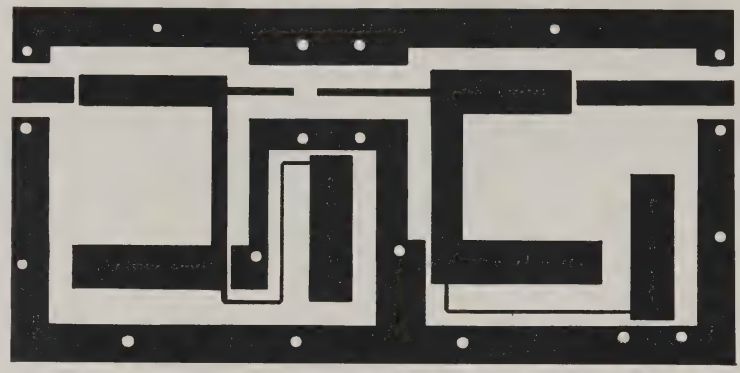
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SINGLE-STAGE GaAsFET LNA



PATTERN FOR ETCHING UPPER SURFACE OF LNA MICROSTRIP BOARD
LOWER SURFACE OF BOARD TO BE PLAIN COPPER.
THIS MAY BE REDUCED BY A FACTOR OF TWO FOR PHOTO-ETCHING.

DIAGRAM 2

down to low frequencies. C1 and C8 isolate the DC bias circuitry from any external DC paths via the RF input and output sockets. The FET operates in common-source, the source connection (the package stud) being grounded directly to minimise lead inductance.

The gate of the FET must always be held negative with respect to the source, and the drain must similarly remain positive. It is advisable to apply (negative) gate bias first, to avoid high drain current when the positive supply is connected, though in practice it is adequate to switch on both supplies simultaneously. The zener diodes D1 and D2 prevent bias voltages rising beyond a safe value in the event of a power supply fault. They also protect the transistor against reverse bias. The meter M1 is included for initial setting-up adjustment and need not be a permanent feature. RV1 enables the gate bias and hence drain current to be adjusted to the value giving best overall noise performance.

The transmission-line networks are

SINGLE-STAGE GaAsFET LNA
COMPONENT LAYOUT

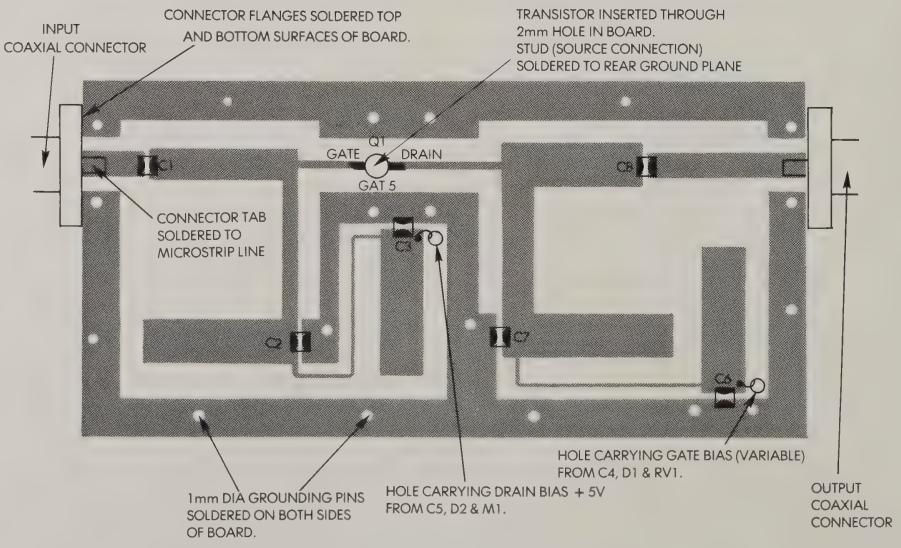


DIAGRAM 3

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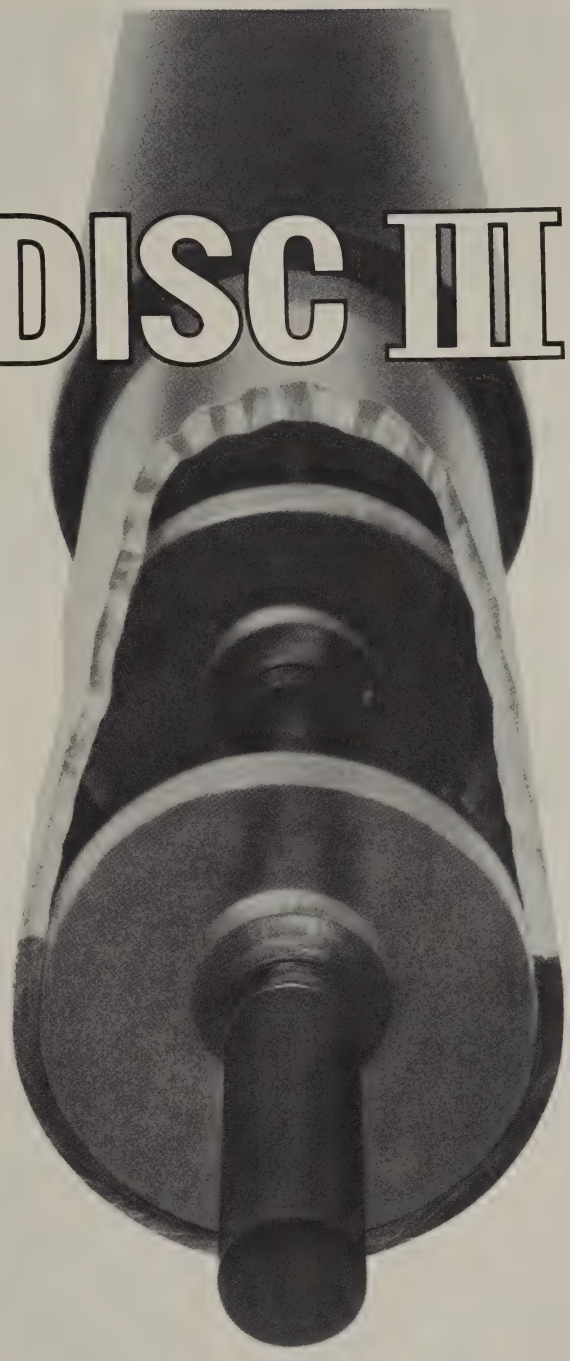
FUSED DISC III	dB per 100 feet	
Cable Size	Nominal	Maximum
.412"	1.42	1.46
.500"	1.15	1.20
.750"	.77	.80
1.00 "	.63	.65

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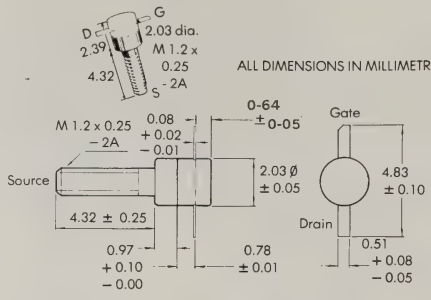


DIAGRAM 4
THE GAT 5 IN P103 PACKAGE

realised on microstrip printed-circuit board. The wider the microstrip lines, the lower their characteristic impedance and velocity factor. On the 0.030 inch teflon-fiberglass laminate used for the prototype, values of Z_0 from 150 down to less than 10 ohms may be achieved, with low loss at 4 GHz. Regular glass fiber board is useless at microwave frequencies, due to its poor dielectric loss characteristics. Plastic laminates, such as RT-Duroid, could provide an alternative if preferred.

Diagram 2 shows the etching pattern for the LNA board. As with the bipolar LNA featured in July 1979, this diagram is 2 x actual size for accuracy of detail, and will need to be reduced to an overall length of 59.5 mm before being used for etching. Alternatively, Real-World Technology can supply ready-etched boards. The component layout on the board's upper surface is shown in Diagram 3. The components not included here (C4, C5, D1, D2 and RV1) may be mounted on the reverse (all copper) side of the board, or on a separate (non-critical) board within the same housing. It is convenient to run wire leads through small holes in the microstrip board to the bias circuitry. C 4, C5, D1 and D2 should not be too far removed from the board, or stability and protective effectiveness may suffer. These components should be connected into circuit before the GaAsFET is removed from its protective packaging, and all precautions taken to avoid build-up of static charge on circuit, tools or body before and whilst handling. I recommend the use of a damp sponge to keep the fingers moist during this stage of construction, while cultivating the habit of keeping a finger in contact with every conductive surface before and during its contact with the FET. That includes board, pliers or tweezers, soldering iron, foil wrapper and FET itself. Soldering iron should be grounded and a conductive bench mat helps—plastic surfaces should be avoided. Take care—GaAsFETs are easily destroyed and mistakes are costly.

The P 103 package is illustrated in Diagram 4. The transistor will push into a 2 mm diameter hole drilled in the board. The source stud can then be soldered around its circumference to the rear ground plane. The threaded portion of the stud is not used in this form of mounting and may be cut off if desired. The slashed lead is the gate connection and should be orientated towards the input socket and the negative bias circuit.

Mounting of the board is at the constructor's discretion. The prototype had no case, being suspended by the input and output connectors, using 0.141 inch semi-rigid cable.

The board could be soldered into a close-fitting box of copper, brass, tinplate, or copper-clad board, solder being run along both top and bottom edges to ensure good grounding. If this is precluded by the case being too large (as when other stages are included) or of the wrong material, ground continuity could be improved by wrapping copper foil strips along the board edges, and soldering top and bottom sides all along.

If the amplifier is used as part of a modular system, with other amplifier stages, SMA coaxial connectors are recommended for interconnections, permitting extra stages to be inserted as desired. If male and female connectors are used for inputs and outputs, stages can be cascaded directly, within the LNA system housing.

Setting-up

Bias supply (negative) to the gate should be applied first, with RV1 set to feed maximum negative bias to the FET. Then, with the milliammeter in circuit, the postive 5 volt supply should be connected. If all is well, zero current will be indicated. RV1 should then be adjusted to steadily reduce the value of negative bias applied to the gate. Drain current will begin to flow, and it should be possible to obtain a full scale meter reading of 25 mA before RV1 reaches the end of its range.

With the LNA in circuit in the TVRO system, bias should be set for 15 mA drain current and the antenna moved just sufficiently off the satellite to give perceptible impulse noise (sparklies). RV1 should now be carefully adjusted while watching the picture until a condition of minimum noise is reached. Color bars are ideal for this test. Dependent on noise figure of the following stage, minimum sparklies should be obtained at a drain current somewhere between 10 and 20 mA. Once satisfied this minimum has been obtained, the meter may be removed from circuit and the antenna re-aligned on the bird.

Performance

We might reasonably expect a gain of at least 10 dB with a noise figure of around 1.5 dB (120°K). Combining this with the two-stage bipolar amplifier of CATJ July 79, gain 20 dB, noise figure 3 dB, will result in an LNA of overall gain 30 dB and noise figure 1.8 dB (149°K).



Russian TV from Statsionar—4 at 14°W, 3695 MHz. Newspaper 'Pravda'.

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For tennis information, contact Ron Harmon, 203 South Broadway, San Antonio, Texas; phone 512/222-0500.

For further information:
CATV, Texas Cable TV Association, John Mankin, Sr., P. O. Box 7488, Tyler, Texas, 75711, 214/593-0335.

If two GAT 5 stages are cascaded, followed by the HXTR-6101's, overall gain could be 40 dB, with a noise figure of 1.6 dB (134 °K).

Should it be found that noise figure varies with precise feed position, or that instability occurs, it is probably due to feed impedance being other than a perfect 50-ohm match. This is only to be expected. Most commercial LNAs get around the problem by placing a ferrite circulator or isolator between antenna feed and LNA input. This ensures that the input circuitry of the LNA 'sees' a good 50 ohms looking back towards the antenna. So the correct source impedance is maintained at the FET's gate, whatever the antenna feed-point impedance. A suitable isolator is Aertech's AMI-3742, having SMA connectors and an insertion loss of typically 0.15 dB. This amount of loss may well be made up by the improved noise figure resulting from correct matching, anyway. An isolator may similarly be placed between stages of an LNA, where interstage matching cannot otherwise be optimised.

Components list and suppliers

Transistor: Q1 GAT 5 / P103. Plessey Optoelectronics & Microwave, 1641 Kaiser Av, Irvine, CA 92714. (714) 540-9945

Diodes D1,2: any 5.6 V 400mW or 1W zener.

RV1: any 10K miniature preset potentiometer.

Circuit board: 59.5 x 26.5 mm, Di-Clad 527, 0.030 inch, dielectric constant 2.55 Keene Corp, Chase-Foster Div, 199 Amaral St. E., Providence, RI 02914. (401) 434-2340

similar materials available from:

Rogers Corp, Micromat Div, PO Box 700, Chandler, AZ 85224 (602) 963-4584

3M Co. Elec Prods Dept, 3M Center 223-4, St. Paul, MN 55101 (612) 733-3350

Oak Inds, Atlantic Laminates, 174 N Main St, Franklin, NH 03235 (603) 934-5736

Microstrip Boards ready-etched: Real-World Technology, 128 Cross House Road, Grenoside, Sheffield, S30 3RX, England. Write air mail for details.

Capacitors: C1, C2, C7, C8, 4.7 pF ceramic chip, Vitramon VJ0805A4R7DF or similar. C3, C6, 1000pF ceramic chip, Vitramon VJ0805X102KF or similar. C4, C5, 0.1 microfarad, Vitramon VJ1808X104KF, or low-voltage disc ceramic.

Vitramon North America, PO Box 544, Bridgeport, CT 06601 (203) 268-6261

similar capacitors available from:

Johanson Dielectric Inc, PO Box 6456, Burbank, CA 91505 (213) 848-4465

JFD Elec Components Corp, 15 Av at 62 St, Brooklyn, NY 11219 (212) 331-1000

Dielectric Labs Inc, 64 Clinton Rd, Fairfield, NJ 07008 (201) 575-8922

ATC Inc, 1 Norden Ln, Huntington Station, NY 11746 (516) 271-9600

SMA coaxial connectors and miniature semi-rigid cable:

Sealectro Corp, 225 Hoyt Street, Mamaroneck, NY 10543 (914) 698-5600

OmniSpectra Inc, Micro Conn Div, 140 Fourth Av, Waltham, MA 02154 (617) 890-4750

Connecting Devices Inc., 125 Lomita St, El Segundo, CA 90245 (213) 322-6885

Ferrite isolator: Aertech AMI-3742 or similar

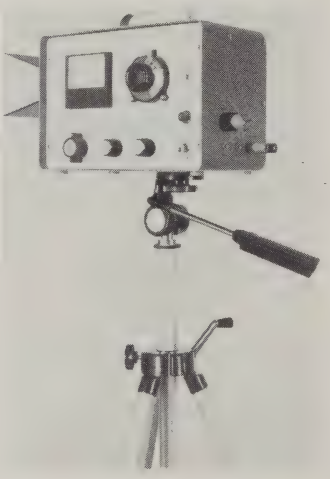
Aertech Inds, 825 Stewart Dr, Sunnyvale, CA 94086 (408) 732-0880

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- Crystal IF Filters
- Integrated Circuit Modulator
- Internal Voltage Regulators
- AFC
- Tone Oscillator

VIDEO MODEL TVX10

- 10 GHz. 10 MW Gunn Transceiver
- 17 dB Horn Antenna
- 45 MHz Low Noise Pre-Amp
- 45 MHz Post IF Amp/Demod
- Audio Subcarrier Mod/Demod
- Room for III Video Channels
- Internal Voltage Regulators
- Volume Control

TM/VIDEO MODEL TM/VX10

- 10 GHz. 10 MW Gunn Transceiver
- 17 dB Horn Antenna
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- 45 MHz Post IF Amp/Demod
- Wideband/Narrowband Operation
- Audio Subcarrier Mod/Demod
- AFC
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- Higher Gain Antennas

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Color: Blue Enclosure, Gray Front Panel
Weight: 3 Pounds
Speaker Included
Tripod or Mast Mounting
Microphone Optional

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CATJ asked CATA's Executive Director, Steve Effros, to prepare a statement that would help to answer some of the questions and solve the dilemma concerning requirements for TVRO's. Below is the most current information prepared by Mr. Effros to whom CATJ extends their thanks as they will be of assistance to clarify the situation for all those with TVRO's, cable system operators and hobbyists as well.

TVRO LICENSE REQUIREMENTS ELIMINATED

The FCC has eliminated all requirements for the licensing of Television Receive-Only Satellite Earth Terminals. This is a move that CATA has been seeking from the Commission for the past year or so, and it has finally happened.

As you may remember, CATA filed the original petition with the Commission to allow cable television operators to use economical small TVRO dishes in 1976. We said at the time that we did not think the Commission had the authority to require licenses for a receive-only facility, but rather than fight that battle at that time, thus delaying our ability to use any earth stations, we decided to get the permission to use them first. CATA won that right at the end of 1976. The application process that was adopted, however, we found to be expensive and burdensome. There was just no good reason for it and it was causing delays. The Commission recognized the problem, and started trying to streamline the process, which they did. However, at the beginning of 1979, it became clear that TVRO applications were going to swamp the Commission as everyone decided to go to the **bird.** So CATA along with other cable interest, went to the Commission and proposed doing away with the application/licensing procedure totally. It was suggested that if anything, all that was needed was a registration procedure, much like the one used for CACs.

It took the Commission quite some time to come out with its decision on this issue—a full rulemaking inquiry was held and most of the commenting parties agreed with us, including the NTIA. The Commission has now agreed also, and they have gone even farther than we expected in deregulating the whole field.

What they have done is this: from now on, effective as of October 18, 1979, when the decision was announced, it is up to the operator's discretion whether or not he files for a TVRO license. Anyone can simply build a TVRO and use it (assuming they have the authority to pick up the signals, which they have to negotiate with the programmers). You do not need to even notify the Commission. You can go out and build it tomorrow if you want. You then have the option to get a license if you want one. As we have pointed out before, a license gives you the right of **protection against future interference** to your earth terminal. That protection can be very important. From CATA's point of view, it is still a good idea to get the license. You can either have a coordination study done and go for the license before you build, or you can build first and then go for the license—it doesn't matter. The point is that **protection** will only be granted to those who get a license. If you don't get one you are on your own and you are assuming the **risk** that you may have trouble with interference in the future.

The Commission has also simplified the process of getting a license. First of all, they have gotten rid of the concept (through a "general waiver") of a "construction permit". That lets you build the terminal, if you want, before you get the license. Second, they have eliminated the requirements that you file a character qualification report (form 430), including financial statements, articles of incorporation, and other such showings. In essence all you have to file is the coordination study and a few sheets of legal jargon along with a form 403 to get your license. Of course if you build first and then apply for the license you are operating at your own risk until the license comes through. That is up to you. Also, the license (and renewal) term has been extended to five years rather than three for all new licenses. For those of you who are almost at renewal time for your first three-year license you have the option of filing for the renewal or not. You will get a five year renewal if you do apply. (See the last issue of CATJ for a renewal form) If you currently have an application on file it will be processed unless you tell the Commission otherwise.

The Commission has not released the actual new rules yet, so we don't know all the details on filing applications in the future, but it should be fairly simple. We will have a full rundown on that in the next issue of the newsletter. Also, the Commission has announced that it will be coming down shortly with some more deregulatory steps in this area. We expect them to designate classes of service (for instance "common carrier" "Cable" "broadcast" and "private"). They will probably allow protection rights for only some classes and not others. They will also deal with the issue of transfers of control and assignments of licenses. These issues were not touched in this decision so we will just have to wait to see what they do. All in all it is a very good decision for cable.

What is the impact of this decision going to be? Well, first of all it is going to cut the "lead time" for putting in a

TVRO. You can build it as soon as the suppliers get it to you. It will make things a little tight for a while on the supplier side because they will no longer have the 60-90 day breathing space they had before between the order and the delivery request. Hopefully after the first crush they will be able to clear that up. Cable operators, if they are smart, will still get a license to protect their terminal site. Yes, it costs money for the coordination study and the filing, but in the long run it is probably worth it, especially if you are in an area that might be subject to future microwave interference. Of course for those who decide not to get a license things are very simple—you just go out and build a dish!

What about home terminals? They are now legal too. At the moment, at least in theory, they will get protection if they are licensed, but we don't think that will last long. For now, anyone can go out and build a terminal.

While some folks may be concerned that home terminals will present a major competitive force to cable, we are not very worried. First of all, a good dish is still not cheap. It is not a "home" type expense that most people would be willing to go for, especially if there is cable in the community and they can get the same services from the cable at a lot lower over-all cost. Sure, the hobby-types will build their terminals and so will the farmers/ranchers who can't get cable service. But they are the minority. The other problem, of course, is that while it is simple for a cable operator to get the rights to use something from the programming services, it is not that easy for a **private** individual. Theft of service will be a problem for a while, but it is more than likely that satellite signals will be scrambled in the near future, so that problem will be solved too.

The FCC also has said that from now on cable operators can share the use of one TVRO so long as it is on a cost-sharing basis (you can't make a profit or you become a common-carrier) without getting any special OK from the Commission. In essence the Commission has decided to really deregulate this whole area, as we asked them to, and they have done a bang-up job of it.

MORE ON TVRO'S

Two more things have come to our attention relating to the TVRO license decision mentioned above. First, the Commission has now announced that you need not get a modification of your license just to go from Satcom I to Satcom III or Westar I or II to the new Westar III. (RCA has asked for permission to put up Satcom IV early next year—they haven't even launched Satcom III yet! That should tell you how good business is!) Anyway, the FCC says that if you have a license for one system (that is Satcom, or Westar), you can look at any of the birds in that system without modifying your license. It is only when you switch systems that you have to get a modification.

Another bit of news about the new decision should be noted by all system operators. The decision does not deal with the issue of 10 foot dishes. That is, so far your application will still have to prove that you can meet the FCC technical requirements, regardless of the size dish, before you will get protection. If you plan to get a 10 footer and it does not meet the "32 minus 25 log theta" rule, you will not get protection. It is not clear as of this writing whether the Commission plans to do anything about relaxing the rules in this area or not.

As these situations develop, you can look to CATA and to CATJ for the current information.

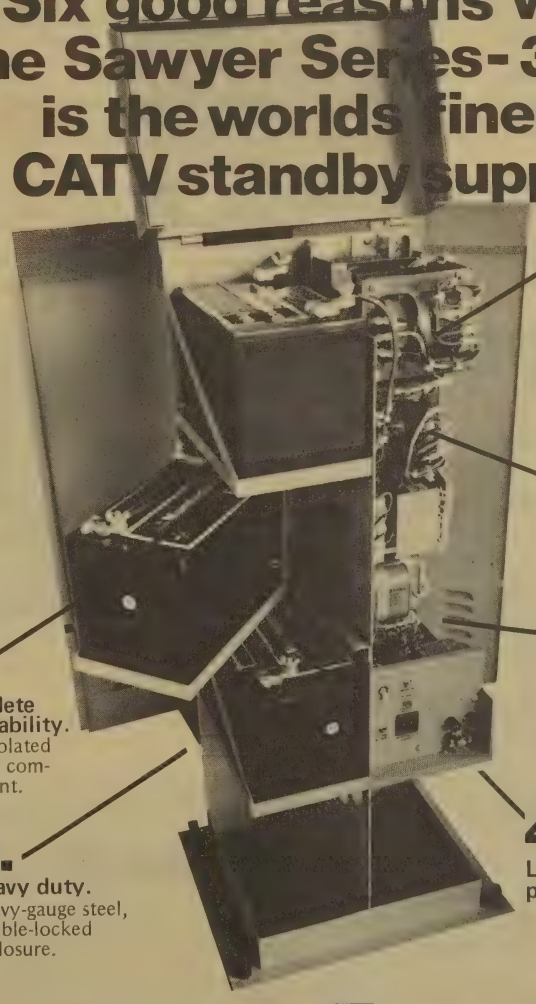
NUMERICAL TRANSPONDER LIST

In response to many requests for this information, we are printing a numerical list of the transponders, listing the service as well as the location. CATJ hopes that this information will be helpful to those that have requested it.

Editor

Transponder Number	Service	Location
1	KTVU	Oakland, CA
2	PTL	Charlotte, NC
3	WGN	Chicago, IL
4	Out of Service	

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7	ESPN	New York
8	CBN	Virginia Beach
9	C-SPAN/MSG	Arlington, VA/ New York
10	Showtime West	New York
11	Star Channel	New York
12	Showtime East	New York
13	Trinity Broadcasting	Tustin, CA
14	Out of Service	
15	RCA Message Traffic	
16	Fanfare	Houston, TX
17	WOR	New York
18	Salavision (SIN)	New York
19	RCA Message Traffic	
20	HBO Spare	New York
21	SPN/HTN	Tulsa/ Portland, ME
22	HBO West	New York
23	HBO Take 2	New York
24	HBO East	New York

List of component manufacturers for Bipolar LNA design published July 1979

Some readers have written to CATJ asking for assistance in locating the component manufacturers for the Bipolar LNA design that was described in the JULY 1979 issue. Following is a list of these manufacturers who would have supply outlets in all major USA cities, though there might be **some** exception. This would be reference material also for future constructional projects to be discussed.

Microstrip printed-circuit laminate substrate material (PTFE-glass)
Keene Corporation, Chase-Foster Division, 199 Amaral St., E. Providence, RI 02914
Rogers Corp., Micromat Div., P.O. Box 700, Chandler, AZ 85224
3M Co., Elec. Prods. Dept., 3M Center, 223-4, St Paul, MN 55101
Oak Industries Atlantic Laminates, 174 N. Main St., Franklin, NH 03235

Microstrip boards ready-etched
Real-World Technology, 128 Cross House Road, Grenoside, Sheffield, S30 3RX, England

SMA Coaxial Connectors
(recommended at 4 GHz)
Sealectro Corp., 225 Hoyt Street, Mamaroneck, NY 10543
OmniSpectra Inc., Microwave Connector Div., 140 Fourth Ave., Waltham, MA 02154
Americon Corp., 87 Rumford Avenue, Waltham, MA 02154
Connecting Devices Inc., 125 Lomita Street, El Segundo, CA 90245

Chip Capacitors (monolithic ceramic microwave)
Vitramon North America, P.O. Box 544, Bridgeport, CT 06601
Johanson Dielectrics Inc., P.O. Box 6456, Burbank, CA 91505
Erie Technological Products, 644 W. 12 Street, Erie, PA 16512
JFD Elec. Components Corp., 15 Ave. at 62 St., Brooklyn, NY 11219
Dielectric Labs Inc., 64 Clinton Rd, Fairfield, NJ 07008
ATC Inc., 1 Norden Ln., Huntington Station, NY 11746

Transistors (this amplifier designed to take only HXTR-6101 or HXTR-6102)
Hewlett-Packard Company, 1507 Page Mill Road, Palo Alto, CA 94304

Most of the listed manufacturers have large numbers of distribution outlets, in major cities throughout the US, and will be able to advise on nearest stockist or supplier.

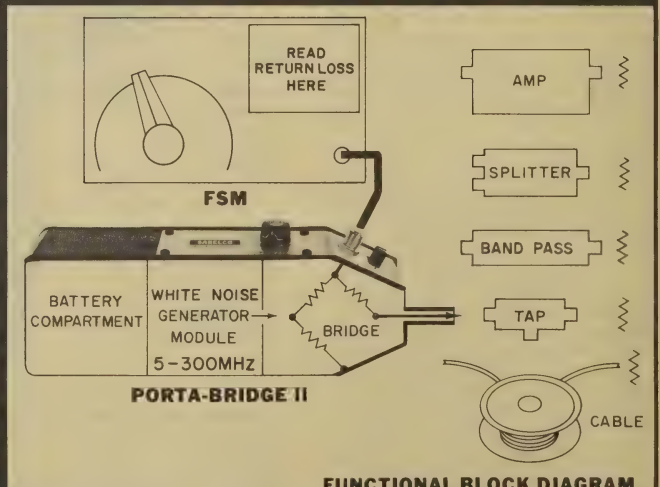
SADELCO'S super
PORTA-BRIDGE II
5-300 MHz
BRIDGE BALANCE: 40 dB

Measure return loss and VSWR without an oscilloscope.
Also gain, loss, amplifier response, splitters, filters and cables.

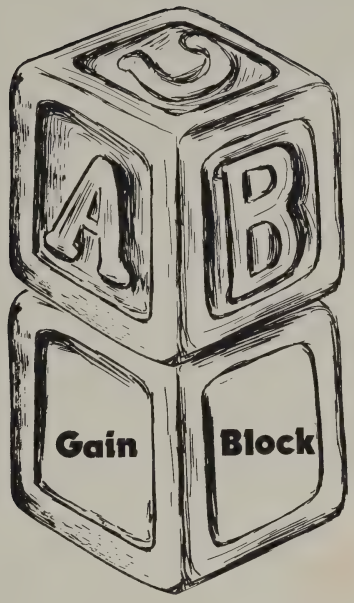


Available at major CATV distributors

Sadelco, INC.
75 W. Forest Ave., Englewood, NJ 07631
(201) 569-3323
General representative for Europe:
Catec AG Luzern/Switzerland, Habsburgerstr 22
Tel. 041-41-75-50 Telex TELFI 78168
IN CANADA: Comm-Plex Electronics Ltd.



FUNCTIONAL BLOCK DIAGRAM

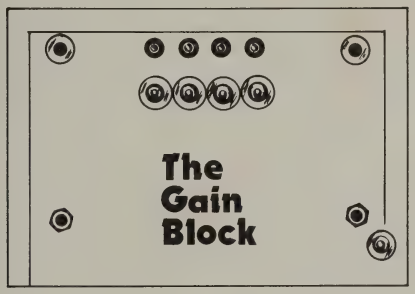


THE GAIN BLOCK

. . .building on a firm foundation. . .

EXPERIENCE IS KNOWLEDGE. The more you do, the more you learn. The latest CATJ 'KIT KORNER' project is just the ticket for the CATV owner/operator, technician or engineer who needs and wants to learn more about the basic "gain-building-blocks" of our industry; hybrid amplifiers.

THE CATJ 'GAIN BLOCK' is both a learning exercise and a valuable bench tool for your CATV system. We selected a very high quality Hewlett Packard gold IC/hybrid device manufactured on a saphire substrate. This 'block' provides 30 dB of gain from below 30 MHz to over 300 MHz (typically 350 + !!). We designed this 'block' into a bench-handy package with a built-in regulated power supply (with external output jacks to power other bench projects), and added a few extra features to make it the most valuable instrument on your CATV test bench!



* - Once you have the basic GAIN BLOCK build and operating (approximately a two hour kit project) we'll be showing you how you can plug in **external** circuits to change gain and passband parameters, build single channel pre-amps, use it as an MDS converter IF 'block' or even as a TVRO low-IF 'block'!

* - the basic GAIN BLOCK has built-in gain controls in three steps using front panel switching of the operating voltage. Outputs of + 53.5 dBmV for 12 channels with cross mod at — 57, second order at -59 and triple beat at -70.5. A very high quality amplifier for bench or system use! (see CATJ for May 1979, page 38).

* - The combination of the basic self-contained GAIN BLOCK, our very extensive construction and operational manuals, and add-on (external!) circuits allow you to work with broadband hybrid circuits, see how they perform, and learn all about the CATV industry's basic tool of "gain".

ENGINEERED TO GROW WITH YOU. More than a construction project kit. More than a super-high gain, high output capability amplifier. GAIN BLOCK is an engineering tool for teaching system technicians what "gain" is all about, how it works and how the amplifiers you work with every day of the week are designed to operate.

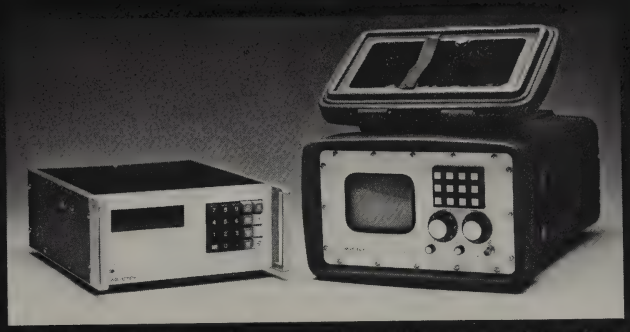
PLAY WITH IT YOURSELF. If you have a sweep signal generator, a detector and a display scope, you'll quickly see how very small changes in input and output circuits can affect the operation of a 'block gain' hybrid device. In working with this super learning tool, you will develop a new appreciation for the trunk and extender amplifiers which you utilize daily in your system.

ALAS — AT THIS PRICE. . .the quantity is limited. We made an especially good buy on these Hewlett Packard gold-plated hybrid devices. When they are gone we'll have to substitute a TRW hybrid chip that costs many times more and the price of the 'GAIN BLOCK KIT' will go up by $40. So act fast. . .like now. . .while our good buy is still available!

Use The Handy Order Card Between Pages 8 & 9! Order Today!


We predict this new program will sweep the nation.
M1 +56 1DBMV 253 0MHZ A TRACE
M2 +54 6DBMV 108 0MHZ HOLD
WAVETEK INDIANA
CATV SWEEP/ANALYZER
MODEL 1865
INTENSITY
POWER ON

It's the Model 1855/65 Sweep Recovery System, an action-packed display of microprocessor ingenuity and Wavetek precision.



Here's the plot: You hand one of these to your system technician, then watch how fast it sets up, how accurately it portrays your system performance, how easily he can balance your trunk.

What will the home viewers think? They won't see a thing, thanks to the unique combination of high speed (down to 1 millisecond) and low level. However, they'll probably notice a steady improvement in your signal.

The star of the show is our microprocessor control. It takes care of most of the setup that used to take so long. Digital signal processing lets the display continuously refresh itself for a bright, accurate picture of the most recent sweep. There's a future option planned for storing the display on magnetic cards or tape. Sweep this fall, rerun next summer.

Alpha-numeric readouts on the screen give amplitude, frequency, even deviation between peak to valley. You haven't seen anything this easy to understand since Sesame Street. The price of the basic Model 1855/65 is $5,800. How's that for a happy ending?

To carry this (no copyright) program on your system, call collect: (317) 783-3221, CATV Dept., Wavetek, Indiana, P.O. Box 190, 66 North First Ave., Beech Grove, IN 46107.

WAVETEK®



TECHNICAL TOPICS

To the Editor:

The August issue of CATJ contains an article by Art Johnson of Oak Communications. Mr. Johnson writes a number of things which I question. Since the topic of scrambling satellite signals is so timely, perhaps you would like to hear another side to the issue.

It is true that a representative of Radio Shack (for whom I once wrote catalogs when they were Boston-based) has been widely quoted as saying that they were looking at the private terminal market, with an eye toward producing a $1000 earth station. However, I don't believe that it will happen soon, if at all. Satellite News reports: "(Their representative) emphasized to us that Radio Shack has begun **no active development** of a home earth station; but if the current examination of the product's possibilities prove favorable, a small earth station could be available in 3 to 5 years. (June 1979 issue)."

Recent information from Radio Shack indicates that they have likely decided against going ahead.

Even so, there will be a growing number of private terminals. But are they illegal, if unlicensed? "Existing laws do not require an FCC license to use a device that simply receives radio communications." U.S. Department of Justice filing in FCC docket No. 78-374 (deregulation of earth stations), March 23, 1979. My own filing suggests that the FCC cannot deregulate what it never had the power to regulate in the first place.

The widespread belief that Section 605 of the Communications Act of 1934 makes it illegal to receive 4 GHz sattelite signals is not supported by a close reading of the statute. It reads:

No person receiving. . .shall divulge. . .; and no person. . .shall intercept. . .and divulge. . .; and no person. . .shall receive and use. . .; and no person having received. . .shall divulge. . .

The conclusion? It is illegal to receive and divulge. It is not illegal to receive.

Recently, the National Association of Broadcasters (mysteriously identified by Mr. Johnson as "a national telecommunications association") petitioned the FCC, in RM-3377, to provide "continued Commission regulation and oversight of a developing technology. . ." Frankly, I think that the last thing we need in this field is "oversight of a developing technology." Perhaps the FCC will do for TV what the DOT did for trains.

Despite the legalities, however, the ultimate question remains: Is it worth it to scramble? I suggest that the answer is no. CableVision reports that we now have about 15 million cable subscribers. Cable News Network advertisements claim that we will have 60 million by next June. My own estimates on the size of the private terminal market lead to the conclusion that, in comparison to the cable market, private terminal reception of programming is a spit in the ocean.

Why scramble to prevent reception by the few, when you risk system reliability for the many? Scrambling techniques are not immune to Murphy's Law. Scrambling adds complexity to the system and increases the likelihood of failures. Furthermore, with 2000 licensed earth stations in existence by the end of next year, descrambling techniques will hardly be a secret.

For as long as we remain at 4 GHz, private terminals will represent a trivial loss of revenues to programmers. Scrambling won't help, but could hurt. It's just not worth it.

Fred Hopengarten
President
Channel One, Inc.

Mr. Hopengarten:

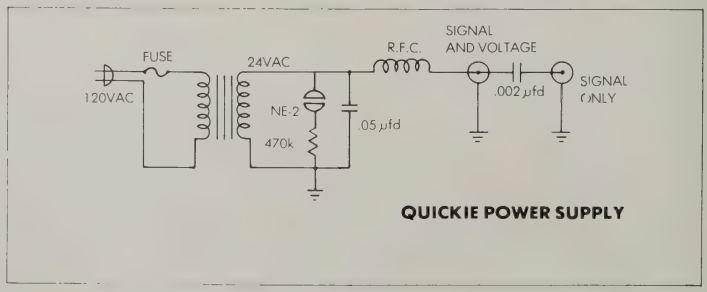
We appreciate your comments as response to SCRAMBLING VIA SATELLITE: A NEW TECHNIQUE FOR THE FUTURE, as carried in Sattellite Technology News on Page 45 of the August CATJ. Since the time of your writing, the FCC has eliminated all requirements for the licensing of Television Receive-Only Satellite Earth Terminals. It is necessary however that one has to negotiate with the signal suppliers to pick up the signals, something that is simple for a cable system operator to get the rights to use, but may not be that easy for a private individual. (See the CATA-torial and the article by Steve Effros, CATA Executive Director, in this issue). We have requested a rebuttal from Mr. Johnson to your comments and that answer will run in the next issue. CATJ would appreciate receiving comments from the readers as to this ongoing dialogue concerning scrambling. What do you think?

QUICKIE POWER SUPPLY

If you ever run short of power supplies for line powering your system the following may be of interest to you.

Our circuit was designed to operate an amplifier which requires approximately 24 volts A.C. However you may, by the selection of different transformers, come up with any voltage you desire.

Although we mounted our power supply on a specially built chassis, you



QUICKIE POWER SUPPLY

may use any configuration which fits your requirements.

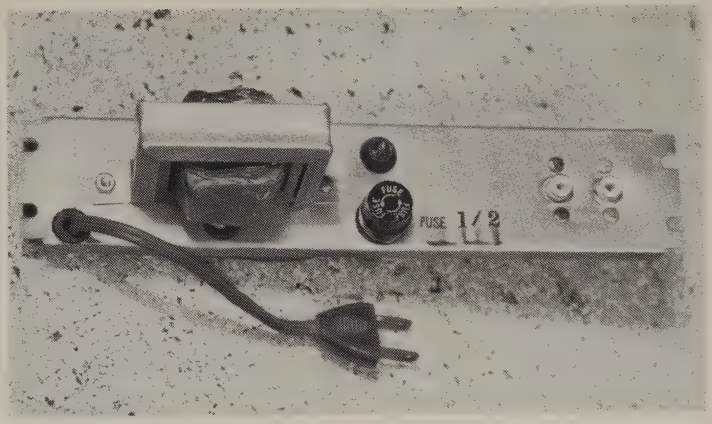
The circuit, shown in Figure 1, is quite simple, consisting of a 24 volt A.C. transformer, a fuse in the 110 volt line, 2 connectors, an R.F. choke, and a blocking and by-pass capacitor.

The selection of a transformer is based on three criteria—1. the amount of voltage your amplifier requires; 2. the amount of current the amplifier draws; and 3. the number of amplifiers you wish to cascade.

A good rule of thumb for the amount of current is to provide half again as much as each amplifier requires. For instance, if your amplifier pulls 1 amp, you should have at least 1½ amps available for each amplifier you wish to cascade.

One side of the output of the transformer is connected to chassis ground and the other side to the out-put voltage terminal of the power supply thru the R.F.C. The purpose of the R.F.C. is to isolate the R.F. signal on the cable from the low impedance of the transformer.

The other signal port of the power supply has no voltage applied to it.



This is accomplished by C2 which, being a .002 ufd, capacitor presents a low impedance to the R.F. signal and a very high impedance to the A.C. voltage.

The R.F. choke consists of approximately 30 turns of number 22 wire, close wound with a diameter of about 1/4" air core.

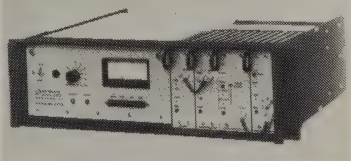
A ½ to 1 amp fuse will provide protection against catastrophic transformer failure and should not blow in the event of short surges.

All parts for the Quickie Power Supply should be available at your local Radio Shack or other part store.

ASSOCIATE SHOWCASE

NEW FREQUENCY AGILE RECEIVER AVAILABLE FOR THE 2300 TO 2680 MHz BAND

Microwave Associates has announced the availability of a new Electronic News Gathering central Receiver. The MA-2GD Receiver provides frequency coverage over any 200 MHz band in the 2300 to 2680 MHz frequency range in ten channels. Dual conversion is used to eliminate the need for channel filters to reject in-ban image signals. The Receiver includes a low noise preamplifier which provides



a Receiver noise figure of 3.5 dB. Receiver threshold is −86 dBm and IF selectivity is available for either 25 MHz or 12 MHz bandwidths.

Channel selection is accomplished via a front panel rotary switch. This function may be remotely controlled with a Microwave Associates Communications remote control system.

The MA-2GD Receiver is housed in a 5-1/4 inch (13.34 cm) high cabinet suitable for rack mounting. Plug-in modular construction is employed in the MA-2GD to facilitate servicing.

Standard frequency Audio Subcarrier Demodulators are available. The unit may be powered from 115 or 230 Vac sources (24 Vdc or 48 Vdc optional).

For more information concerning this news release, contact: Microwave Associates Communications, Burlington, Massachusetts 01803, (617) 272-3100.

MODEL V-TEC/1H
VIDEO TIME AND ERROR CORRECTOR

Video Data Systems' new V-TEC, Video Time and Error Corrector utilizes the latest CCD memory technology and several innovative circuit designs (patents pending) to correct the real world problems encountered with video tape signals beside time error.

Priced at $3450.00, V—TEC provides features hereto not available at this price: processing amplifier, video level monitoring, new design peak video ASC sensing, sync level and loss of video monitoring, dual chroma AGC, pulse cross of both corrected and uncorrected signals, adjustable added blanking width, corner insert split screen display, and automatic sensing of color or monochrome signals for burst and chroma channel kills.

Video Data Systems', V-TEC, through uniquely designed sync stripping, sync insertion, and AGC circuits tolerates relatively large errors between sync and picture information in signal levels and condition, previously not correctable in low cost units. V-TEC's non-conventional method of sync stripping references the video signal back to itself instead of a DC level. Low sync levels, noisy pulses or abrupt level changes no longer cause sync separator misoperation.

A major design improvement provides a more effective automatic gain control (AGC) to maintain proper video levels and eliminate audio buzz problems. Instead of referencing the video level to sync, which many times is in error, V-TEC reads peak video levels referenced to black level, not sync tip. In addition to video AGC, a

ASSOCIATE ROSTER

AmeriCom Satellite Network, Inc., (A.S.N.), 310-14th Ave. South, St. Petersburg, FL. 33701 **(S4)** 813—895-4201
Anixter-Pruzan, Inc., P.O. Box 88758, Tukwila Branch, Seattle, WA. 98188 **(D1)** 206—251-6760
Avantek, Inc., 3175 Bowers Avenue, Santa Clara, CA 95051 **(M8)** 408—249-0700
Bankers Trust Company, 280 Park Ave., New York, N.Y. 10017 **(S3, S9)** 212—692-2430
Belden Corp., Electronic Division, P.O. Box 1327, Richmond, IN 47374 **(M3)** 317—966-6661
B.E.I. (BESTON ELECTRONICS, INC.), P.O. Box 106A, Olathe, KS 66061 **(M9 Character Generators)** 913—764-1900
Bethlehem Tower Works, P.O. Box #68, Harrison, Ark. 72601 **(M9)** 501—741-9031
BLONDER-TONGUE LABORATORIES, One Jake Brown Rd., Old Bridge, N.J. 08857 **(M1, M2, M4, M5, M6, M7)** 201—679-4000
BROADBAND ENGINEERING, INC., 1525 Cypress Dr., Jupiter, FL 33458 **(D9, replacement parts)** 1-800-327-6690
Budco, Incorporated, P.O. Box 4593, Tulsa, OK 74120 **(D9 Security & Identification devices)** 918—584-1115
Cable TV Supply Company, 11505 West Jefferson Blvd., Culver City, CA 90230 **(D1, D2, D3, D4, D5, D6, D7, D8, M5, M6)** 213—390-8002
CCS HATFIELD/CATV DIV., 5707 W. Buckeye Rd., Phoenix, AZ. 85063 **(M3)** 201—272-3850
C-COR ELECTRONICS, Inc., 60 Decibel Rd., State College, PA 16801 **(M1, M4, M5, S1, S2, S8)** 814—238-2461
Century III Electronics, Inc., 3880 E. Eagle Drive, Anaheim, CA 92807 **(M1, M3, M4, M5, M7, M8, S1, S2, S8)** 630-3714
Cerro Communication Products, Halls Mill Rd., Freehold, N.J. 07728 **(M1, M3, M4, M5)** 201—462-8700
Channel Master, Div. of Avnet, Inc., Ellenville, N.Y. 12428 **(M2, 3, 4, 5, 6, 7)** 914—647-5000
COLLINS COMMERCIAL TELECOMMUNICATIONS, MP-402-101, Dallas, TX 75207 **(M9, Microwave)** 214—690-5954
COMM/SCOPE COMPANY, Rt. 1, Box 199A, Catawba, NC 28609 **(M3)** 704—241-3142
COMMUNICATIONS EQUITY ASSOCIATES, 651 Lincoln Center, 5401 W. Kennedy Blvd., Tampa, FL 33609 **(S3)** 813—877-8844
Compucon, P.O. Box 401229, Dallas, Tx. 75240 **(S8)** 214—233-4380
COMPUTER VIDEO SYSTEMS, INC., Suite E, 6290 McDonough D., Norcross, GA 30093 **(M9)** 404—449-3800
Comsearch, Inc., 2936 Chain Bridge Rd., Oakton, VA 22124 **(S8, S9 earth station placement frequency coordination)** 703—281-5550
ComSoncis, Inc., P.O. Box 1106, Harrisonburg, VA 22801 **(M8, M9, S8, S9)** 703—434-5965
Comtech Data Corporation, 15207 N. 75th, Scottsdale, AZ 85260, **(M2, M6)** 602—991-9580
Continental Lift Corp., RR 2, Box 9, Austin, Minn. 55912 507—433-7387
CRC ELECTRONICS, INC., 2669 Kilihau St., Honolulu, HI 96819 **(M9 Videotape Automation Equipment)** 808—668-1227
CWY Electronics, 405 N. Earl Ave., Lafayette, Ind. 47904 **(M9, D1)** 317—447-4617
Daniels & Associates, 2930 E. 3rd Ave., Denver, Colo. 80206 **(S3, S9 Brokerage)** 303—321-7550
DAVCO, INC., P.O. Box 861, Batesville, AR 72501 **(D1, S1, S2, S8)** 501—793-3816
DF Countryman Co., 1821 University Ave., St. Paul, MN 55104 **(D1, S1, S8)** 612—645-9153
Durnell Engineering, Inc., Hwy. 4 So., Emmetsburg, Iowa 50536, **(M9)** 712—852-2611
EALES COMM. & ANTENNA SERV., 2904 N.W. 23rd, Oklahoma City, OK 73107 **(D1,2,3,4,5,6,7,S1,2,S7,8)** 405—946-3788
Entertainment and Sports Programming Network, 319 Cooke St., Plainville, CN 06062 **(S9)** 203—747-6847
FARINON ELECTRIC, 1691 Bayport, San Carlos, CA 94070 **(M9, S9)** 415—592-4120
FERGUSON COMMUNICATIONS CORP., P.O. Drawer 871, Henderson, TX 75652 **(S1, S2, S7, S8, S9)** 214—854-2405
Gardiner Communications Corp., 1980 S. Post Oak Rd., Suite 2040, Houston, TX 77056 **(M9 TVRO Packages, S1, S2, S8)** 713—961-7348
General Cable Corp., 1 Woodbridge Center, P.O. Box 700, Woodbridge, N.J. 07095 **(M3)** 201—636-5500
GILBERT ENGINEERING CO., P.O. Box 14149, Phoenix, AZ 85063 **(M7)** 602—272-6871
GTE Sylvania, P. O. Box 239, Lilburn, Ga. 30247
Harris Satellite Comm. Antenna Operations Division, P.O. Box 1277, Kilgore, TX 75662 **(M2, M9, S2)** 214—984-0555
Heller-Oak Communications Finance Corp., 105 W. Adams St., Chicago, IL 60603 **(S3)** 312—621-7661
HOME BOX OFFICE, INC., 7839 Churchill Way—Suite 133, Box 63, Dallas, TX 75251 **(S4)** 214—387-8557
HUGHES MICROWAVE COMMUNICATIONS PRODUCTS, 3060 W. Lomita Blvd., Torrance, CA 90505 **(M9)** 213—534-2146
IBM Corp., P.O. Box 2150, Atlanta, GA 30301 404—231-6005
JERROLD Electronics Corp., P.O. Box 487, Byberry Rd. & PA. Turnpike, Hatboro, PA 19040, **(M1, M2, M4, M5, M6, M7, D3, D8, S1, S2, S3, S8)** 215—674-4800
JERRY CONN ASSOCIATES, INC., P.O. Box 444, Chambersburg, PA 17201 **(D3, D4, D5, D6, D7, D8)** 717—263-8258

PROTECT YOUR EARTH STATION SERVICE

Lightning is a constant threat to TVRO low noise amplifiers. Delicate, expensive GaAs-FET amplifier devices have a very low tolerance for lightning surge, or even normal primary AC switching transients. Downtime is expensive! The ECA LNA PS-1 is the answer. For a $205 investment, you have a fully automatic, maintenance free Gel cell supply for one or two LNAs, totally isolated from AC surges and transients. Rack mounting, availability stock to one week from receipt of order.

ELECTRON CONSULTING ASSOCIATES
P.O. Box 2029 • Grove, Ok. 74344 (918/786-5349)

Klungness Electronic Supply, P.O. Box 547, 107 Kent Street, Iron Mountain, MI 49801 **(D1, D8, S2, S8)** 906—774-1755
LARSON ELECTRONICS, 311 S. Locust St., Denton, TX 76201 **(M9 Standby Power)** 817—387-0002
LRC Electronics, Inc., 901 South Ave., Horseheads, N.Y. 14845 **(M7)** 607—739-3844
Magnavox CATV Division, 133 West Seneca St., Manlius, N.Y. 13104 **(M1)** 315—682-9105
MCE CORP., P.O. Box 1341, 2629 N. 24th Dr., Phoeniz, Ariz. 85002 **(M4, M9)** 602—271-9181
MetroData Corp., 2150 North 107th, Suite 420, Seattle, Wa. 98133 **(M9)** 206—367-2100
MICRODYNE CORPORATION, P.O. Box 1527, 627 Lofstrand La., Rockville, MD 20850 **(M9 Satellite TV Recs.)** 301—762-8500
MICROWAVE ASSOCIATES, INC., 777 S. Central Expwy., Suite 4-C, Richardson, TX 75080 **(M9 Microwave Radio Systems)** 816—891-8895
Microwave Filter Co., 6743 Kinne St., Box 103, E. Syracuse, N.Y. 10357 **(M5 Bandpass Filters)** 315—437-4529
MID STATE Communication, Inc., P.O. Box 203, Beech Grove, IN 46107 **(M8)** 317—787-9426
Modern Cable Programs Division of Modern Talking Picture Service, Inc., 2323 New Hyde Park Road, New Hyde Park, NY 11042 **(S4)** 516-437-6300
MSI TELEVISION, 4788 South State St., Salt Lake City, UT 84107 **(M9 Digital Video Equip.)** 801—262-8475
National Screen Service Corp., 1600 Broadway, New York, NY 10019 **(M9)** 212—246-5700
NORTHERN CATV DISTRIBUTORS, INC., 8016 Chatham Dr., Manlius, NY 13104 **(D1)** 315—682-2670
OAK INDUSTRIES INC./CATV DIV., Crystal Lake, IL 60014 **(M1, M9 Converters, S3)** 815—459-5000
PRODELIN, INC., 1350 Duane Avenue, Santa Clara, CA 95050 **(M2, M3, M7, S2)** 408—244-4720
Q-BIT Corporation, P.O. Box 2208, Melbourne, FL 32901 **(M4)** 305—727-1838
Reuters, 1212 Avenue of the Americas, 16th Floor, New York, N.Y. 10036 **(D9)** 212—730-2715
RMS CATV Division, 50 Antin Place, Bronx, NY 10462 **(M5, M7)** 212—892-1000
Sadelco, Inc., 299 Park Avenue, Weehawken, NJ 07087 **(M8)** 201—866-0912
SATCO, P.O. Box 1260, Lewisville, TX 75067 **(M4)** 214—436-9509
Scientific Atlanta Inc., 3845 Pleasantdale Rd., Atlanta, GA 30340 **(M1, M2, M4, M8, S1, S2, S3, S8)** 404—449-2000
SCIENTIFIC COMMUNICATIONS, INC., 3425 Kingsley Rd., Garland, TX 75041 **(M4 Low Noise & Parametric)** 214—271-3685
Sherman and Brown Associates, P.O. Box 4475, Ft. Lauderdale, Fla. 33338 **(S3)** 305—561-9334
Showtime Entertainment, Inc., 1211 Ave. of the Americas, New York, NY 10036 **(S4)** 212—575-5175
Southern Satellite Systems, Inc., P.O. Box 45684, Tulsa, OK 74145 **(S9)** 918—664-4812
Systems Wire and Cable, Inc., P.O. Box 21007, Phoenix, AZ 85036 **(M3)** 602—268-8744
Tele-Wire Supply Corp., 122 Cutter Mill Rd., Great Neck, N.Y. 11021 **(D1, 2, 3, 5, 6, 7, 8, 9)** 516—829-8484
T.E.S.T., Inc., 16130 Stagg St., Van Nuys, CA 91409 **(M9 Encoders & Decoders)** 213—989-4535
TEXSCAN Corp., 2446 N. Shadeland Ave., Indianapolis, IN 46219 **(M8 Bandpass Filters)** 317—357-8781
The Associated Press, 50 Rockefeller Plaza, New York, NY 10020 **(S9 Automated News SVC)** 212—262-4014
Theta-Com CATV, Division of Texscan Corporation, 2960 Grand Avenue, Phoenix, AZ 85061, **(M1, M4, M5, M7, M8)** 602—252-5021
TIMES WIRE & CABLE CO., 358 Hall Avenue, Wallingford, CT 06492 **(M3)** 203—265-2361
Tocom, Inc., P.O. Box 47066, Dallas, TX 75247 **(M1, M4, M5, Converters)** 214—438-7691
TOMCO COMMUNICATIONS, INC., 1077 Independence Ave., Mtn. View, CA 94043 **(M4, M5, M9)** 415—969-3042
Toner Cable Equipment, Inc., 969 Horsham Rd., Horsham PA 19044 **(D2, D3, D4, D5, D6, D7)** 800—523-5947, In Penna. 800—492-2512
Triple Crown Electronics Inc., 42 Racine Rd., Rexdale, Ontario, Canada M9W2Z3 **(M4, M8)** 416—743-1481
TURNER COMMUNICATIONS CORP., (WTCG-TV), 1018 West Peachtree St., Atlanta, GA 30309 **(S9)** 404—875-7317
UNITED PRESS INTERNATIONAL, 220 East 42nd St., New York, NY 10017, **(S9 Automated News Svc.)** 212—682-0400
UNITES STATES TOWER & FAB. CO., P.O. Drawer "S", Afton, OK 74331 **(M2, M9)** 918—257-4257
United Video, Inc., 5200 S. Harvard, Suite 4-D, Tulsa, OK 74135 **(S9)** 918—749-8811
Van Ladder, Inc., P.O. 709, Spencer, Iowa 51301 **(M9, Automated Ladder Equipment)** 712—262-5810
VIDEO DATA SYSTEMS, 40 Oser Avenue, Hauppauge, NY 11787 **(M9)** 516—231-4400
VITEK ELECTRONICS, INC., 4 Gladys Court, Edison, NJ 08817 201—287-3200
Warner Cable Television, 75 Rockefiller Plaza, New. City, N. Y. 10019
WAVETEK Indiana, 66 N. First Ave., Beech Grove, IN 46107 **(M8)** 317—783-3221
WEATHERSCAN, Loop 132, Throckmorton Hwy., Olney, TX 76374 **(D9, Sony Equip. Dist., M9 Weather Channel Displays)** 817—564-5688
Western Communication Service, Box 347, San Angelo, TX 76901 **(M2, Towers)** 915—655-6262/653-3363
Winegard Company, 3000 Kirkwood Street, Burlington, Iowa 52601 **(M2, M3, M4, M5, M7)** 319—753-0121

wide range chroma AGC circuit functions off incoming burst amplitude, and also contains a chroma "overload AGC" which steps in if relative levels between burst and chroma are drastically out of proportion.

Improved processing amplifier designs eliminates any line to line time variation between sync on the input video and regenerated sync, reduced vertical blanking and chroma channel noise.

In short Video Data System" V-TEC corrects video tapes previously not playable through other low cost units without picture breakup.

New operator functions provide either pulse cross of the corrected or uncorrected signals without the use of special monitors, or a corner insert split screen display, level monitoring and signal loss indication.

For additional information write or phone:

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VIDEO DATA SYSTEMS
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Salt Lake City, Utah 84121
801/272-9296

"FLIGHT PACK 1TM" AIRCRAFT ENG SYSTEM

A new Electronic News Gathering (ENG) television microwave system has been announced by Microwave Associates. The Flight Pack 1TM is specifically designed to give broadcasters a simple-to-use microwave system suitable for program origination onboard an aircraft or for use as an airborne repeater.

The Flight Pack 1TM system was first field tested by WBZ-TV, Boston, during the recent running of the

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Boston Marathon. Coverage of the race was provided live from start to finish along the entire 26 mile route.

Erik Stomsted, Marketing Manager of Microwave Associates Communications said that the Flight Pack 1™ is a completely self-contained unit which includes a standard MA-2CP Transmitter, an MA-2P Receiver, a 12W Power Amplifer (PA-315), a complete duplexer for simultaneous transmission and reception and the necessary power supplies to permit the entire system to operate from the supply voltage (24 vDc) found on most aircraft. The complete Flight Pack 1™ may be installed on an unoccupied seat, on the floor or in a storage compartment in a matter of minutes. Once installed, the Flight Pack 1™ may be separated into two modules. The radio module containing the Transmitter and Receiver may be removed to a secured area if the aircraft is to be unattended. The less conspicuous support module with power supplies remains behind. Reinstallation takes place in seconds.

Broadcasters may select two modes of operation. In the transmit mode, an ENG camera team originates coverage of an event from the air. Mr. Stromsted noted that this is ideal for parades and special events coverage as well as for fast response to almost any news event. A 12 Vdc output for the camera is also provided by the Flight Pack 1™ so that very little additional equipment is required.

In the repeat mode, the Flight Pack 1™ enables the aircraft to become an airborne relay point to greatly extend the normal operating range of an ENG team on the ground. In this mode, the 2 GHz signal from the ground based microwave Transmitter is received on one channel and simultaneously retransmitted on a second channel back to the TV stations central receive site. Because of its altitude above ground, the Flight Pack 1™ would extend the normal range of a ground based ENG team by several times, even in mountainous terrain.

The Flight Pack 1™ system also includes the newly developed "Omnex ™" Antenna, which is mounted underneath the fuselage of the aircraft.

For further information concerning this news release, contact: Microwave Associates Communications, Burlington, Massachusetts 01803, (617) 272-3100.

CLASSY-CAT advertising is handled as a no-charge membership service of and by CATA. The rules are as follows:

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(405) 765-4011

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LNA Boards for Birkills Amp in July "79" CATJ $15.00. Help me avoid copyright problems please zerox a copy of circuit. Hp application note #967 board for HXTR-6101-2 transistors $7.50 Norman Gillaspie 2225 Sharon Rd. #224 Menlo Park, CA 94025.

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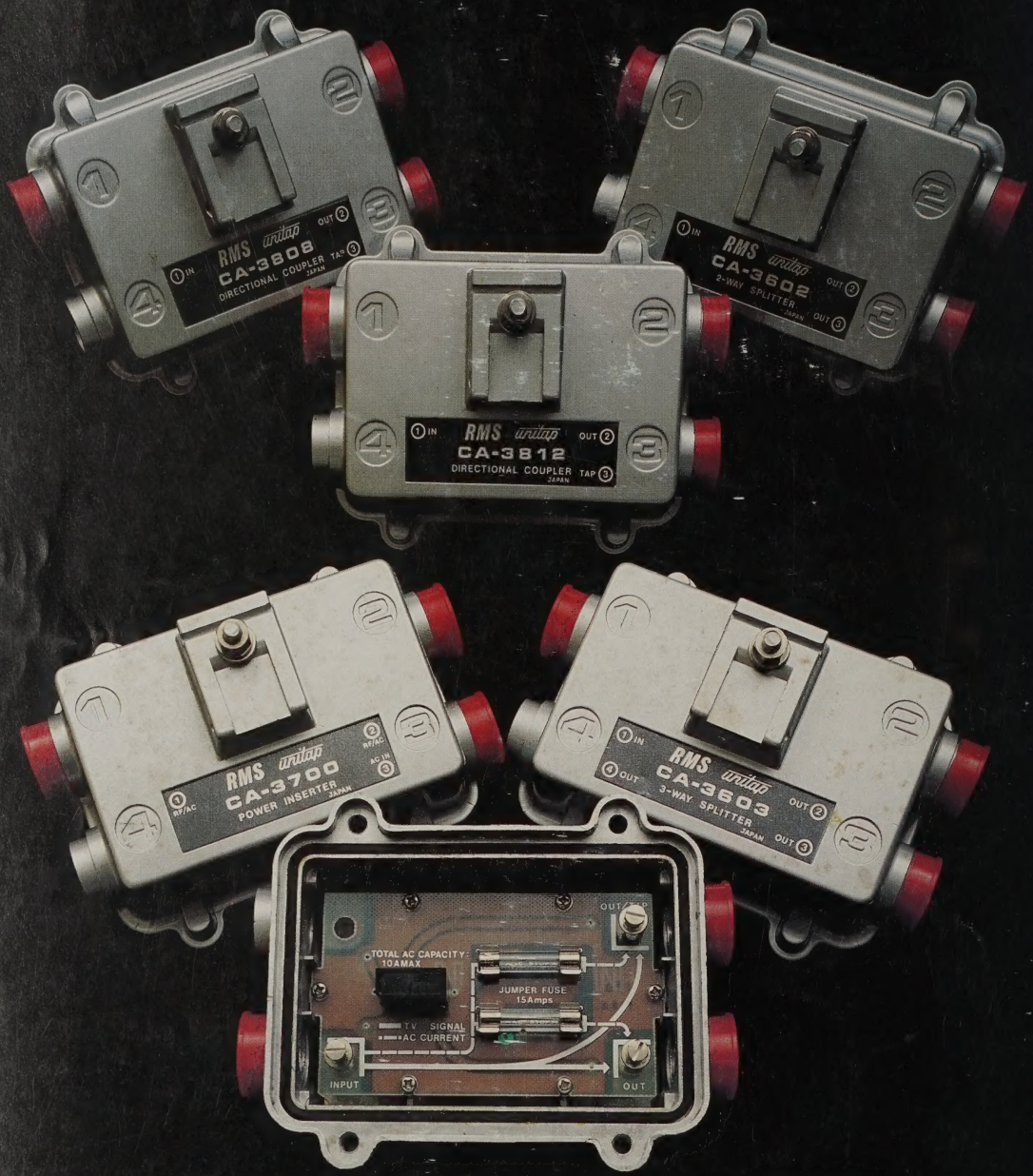
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